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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue
NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

The news that the New York elevated railway lines will, within a few months, be equipped with electric power will be welcome to the many thousands who travel on them daily.

While everybody has been predicting the ubiquity of the electric automobile as soon as the proper storage battery is devised, the fact that another interesting automobile application of electricity will be equally as much stimulated by such a battery has generally been lost sight of. Just so surely as the electric automobile will be the favorite both for business and pleasure uses, so the electric boat will take the place of the gasoline, naphtha and steam yacht on our waters when the storage battery enters into its kingdom.

AUTOMATIC RAILWAYS.

The high-speed traction experiments which have lately been carried on in Germany, and in which alternating-current transmission and polyphase motors were used, seem to have been remarkably successful. If, as was shown, it is possible to obtain speeds far greater than those of our present railways, and to do this with a simplicity of apparatus that is almost phenomenal, it seems no long step to the automatic railway.

By this term is meant the railway for the carriage of goods, mails, etc., in which the cars are run without the presence of any controlling intelligence aboard them. There seems to be no reason to-day why the railway may not be regarded as a mechanical unit, and with electrical methods of control and power transmission why the intelligence necessary for the guidance of its cars can not be concentrated at a stationary point instead of distributed in the trains themselves. Perhaps to-day it would be a step too far to suggest that such a method could be applied to passenger trains, but is there any reason whatever why it should not work practically for merchandise-carrying trains and why we may not live to see the high-speed mail and express railway running long distances and controlled from a central office at some convenient point?

The idea is not as chimerical as it may seem. Perhaps the largest factor in the expense of operating railways to-day is the labor cost and a good deal of this cost is due to the high wages earned by the excellent class of men necessary to direct the movements of trains from the locomotive cab. In these days of automatic and labor-saving machinery it seems that the automatic engine driver must certainly come. How easily an automatic railway could be designed should be evident to all who are familiar with the applications of electricity to railroads, while its value, for certain purposes, is incontestable.

INVENTION.

There have been some critics of the progress of electricity who have reached the melancholy conclusion that invention is on the wane, that the great progressive steps in the development of the art have all been taken, leaving to inventors of this generation only the smaller opportunity of improving upon the work of their predecessors. All that is necessary to refute this point of view is a glance at the pages in another part of this number devoted to recent electrical patents.

Never before in the history of the electrical arts has the activity of inventors resulted in such an outpouring of patents and such a bringing to the surface of new devices and new ideas as there is at present. It is true that we have failed to develop anything very revolutionary in the last six months, but the twentieth century has already started in with a notable record in electrical invention. Invention, like fashion, follows certain lines at certain times, and the activities of engineers and designers are directed by external causes into one channel to-day and another to-morrow. At present the improvement of the electric light and very radical improvements in telephony seem to be the directions of greatest advance, although the electrochemical arts, particularly with reference to improvement of the storage battery, are furnishing a field little, if any, less fertile. Already, since the beginning of this year, a number of patents have been granted in the United States Patent Office which seem, in the light of contemporary observation, at least, to be destined to greatness. It is only necessary to mention the Nernst lamp, the Pupin telephone circuit, the Edison storage battery, the Cooper Hewitt vacuum lamp, to call to mind others of perhaps equal significance.

As the field of electrical operations increases its boundaries are ever widening, and the particulars presented are constant-

ly and notably increasing. Every new development that is made brings with it in its turn a source of new possibilities, and points the way for new directions of endeavor. Rather than be pessimistic, we should all be permeated with hopefulness, for the outlook is distinctly promising in practically every direction of electrical activity.

THE STORAGE BATTERY.

The records of the Patent Office give evidence of renewed activity on the part of inventors in the storage battery field. During the past year a number of patents of evident great importance have been issued, and several entirely new types of storage batteries have been brought out. In this issue is illustrated a new type for which patents have just been granted Mr. T. A. Edison. This battery is quite different from the iron-nickel-potash cell recently produced by the same inventor, though, like the latter, considerably different from the ordinary forms.

So far the first serious attempt to devise a battery in which lead or some of its compounds does not enter is that of Mr. Edison, and it is to be hoped that his efforts will meet with commercial success. It is useless here to dwell upon the commercial importance of a design of storage battery having smaller intrinsic weight than the lead types of cell now in general use. For one thing, the automobile problem would be solved by the production of such a cell, while many other uses suggest themselves immediately.

In France, the last two years have been productive of some very interesting results in the testing of batteries of a sort perhaps best described as plated metal cells. In these the electrolyte is a salt of a metal, such as zinc or cadmium, and the latter is deposited on the negative electrode during charge and dissolved off during discharge. Investigations along this line certainly seem promising and doubtless will lead to important commercial results.

In another type of cell the electrolyte is such as can be decomposed into an acid and a base by the passage of current, and the reunion of these two produces the current of discharge. Such a battery was brought out by a Spanish *savant* about three years ago, the electrodes being of porous carbon and the electrolyte a solution of ammonium chloride. While the battery rapidly lost its charge on open circuit, extraordinary efficiency and great power were claimed for it as a regulating cell. Surely in this direction there is much that will repay research.

The principle of the Grove gas battery seems not to have been followed as assiduously by experimenters as the promise it holds forth would suggest. Practically any reversible chemical reaction will serve as the fundamental basis for making a storage battery, and it is to be hoped that from the many combinations possible and the great variety of substances from which choice may be made, some set of chemical elements and some reaction among them may be found which will result in the production of a type of cell at once lighter, stronger and more efficient than those now in use.

While invention has been active improvement has been steadily made in the lead cell until it has been made as good or better than the most ardent expectations of its originators foresaw. The engineers who have developed the storage battery and the capitalists who have financed its exploitation are both deserving of all the credit that can be assigned them, credit not only for efficient work but for accomplished results.

AUTOMOBILE DESIGN.

There was one fact brought out in the recent automobile exhibition in New York which has not apparently attracted its fair proportion of comment. This is, that makers of automobiles still adhere closely to lines and patterns furnished them by the carriage makers' art. Perhaps this is due to an innate conservatism which characterizes the race, but whatever may be its cause it is certainly a regrettable circumstance and one that it is hoped future designers will modify. In the bicycle there has been developed one of the most entirely satisfactory machines that is known so far as regards its weight-carrying capacity, its smoothness of operation, its endurance and its fitness for the purpose for which it is designed. To compare the automobile of to-day with its carriage body lines with the automobile that must be designed under the promptings of necessity—when the manufacturers get down to business and abandon the race track and the boulevard as their field of operations—will be something like comparing the wheelbarrow with the twentieth century bicycle. The question naturally arises, where is the originality of our designers and why should the traditional forms of vehicles intended for horse traction endure in the new designs of mechanically propelled automobiles? It is a hard one to answer, and the fact—for it is an undoubted fact—is certainly unfortunate. It is to be hoped that some designer will cast off tradition and give us an automobile that looks like an automobile, built on mechanical lines with careful adaptation for the work it is to do and the circumstances under which it is to do it.

INCANDESCENT LAMPS FOR STREET LIGHTING.

In a large number of places a particularly vexatious problem is presented by streets lightly traveled at night, requiring light, yet for which the municipal authorities are not willing to pay the prices charged for arc lighting. The Welsbach lamp is making considerable inroads in such places and it is of importance to devise a better and cheaper system than the Welsbach, or, rather, one which may be easily proven to be cheaper and better to the satisfaction of municipal lighting committees. In Providence, R. I., recourse is had to series incandescent lamps of about thirty-five candlepower, operated either on direct current or alternating current of low periodicity, and the results have been entirely satisfactory both to the electric light company and to the public. The light is far superior to the Welsbach, especially after the latter has been in use for several days, and the difficulty of lighting the lamps and extinguishing them at the proper hours is naturally entirely obviated with the electrical system. It is to be hoped that with the improved incandescent lamp of to-day these systems may be made more satisfactory than they were several years ago, and the experience at Providence leads to the belief that other companies would find it advantageous to examine into the merits of incandescent lamps for street lighting.

Meanwhile, the Nernst lamp looms up on the horizon as a most entirely satisfactory light for street purposes. Intermediate in intensity between incandescent and arc lamps the new light promises to be a serious and important factor in the question of street lighting as soon as it is put commercially upon the market. The quality of the light and its complete steadiness will recommend it to the public, while its high efficiency, approaching that of the arc lamp, will recommend it to the lighting companies.

Science Brevities

Quantitative Estimation of Copper in Pyrites—A quick and exact method for the quantitative estimation of copper in pyrites by precipitation with aluminum and electrolysis is given by C. N. Heidenrich in *Zeitschrift für Analytiche Chemie,* and abstracted in the London *Electrical Engineer.* Two to five grammes pyrites are dissolved in aqua regia, the nitric acid evaporated off, and the residue redissolved in five cubic centimetres of dilute hydrochloric acid and ten cubic centimetres of water. The whole is washed into an Erlenmeyer, diluted to 100 cubic centimetres, and warmed with excess of sheet aluminum on the sand bath. When the solution is colorless, showing that all the iron oxide is reduced, the solution is filtered and the residue (copper and aluminum) is washed free from chlorine, the filter paper burned, and the copper and aluminum dissolved in nitric acid. The copper is then subjected to the ordinary electrolytic estimation.

Radioactive Lead — Herrn Hofmann and Strauss have obtained radioactive lead salts from various rare minerals. These authors have recently described further investigations upon the subject, the results of which have been published in the *Berichte* and digested in the *American Journal of Science.* They are still of the opinion that this radioactive substance differs in many respects from ordinary lead in its chemical behavior, but they have not yet obtained it in a pure state. They find that, while the various salts of radioactive lead have nearly the same action upon the electroscope, only the sulphate is capable of acting upon the photographic plate through glass or aluminum; moreover, the sulphate becomes particularly active in the latter respect after having been evaporated with nitric and sulphuric acids, or after having been ignited at 450 degrees for fifteen hours with access of air. It appears also, that while radioactive lead sulphate acts more energetically upon the photographic plate than certain polonium (radioactive bismuth) preparations, the latter have a much greater action in discharging the electroscope. The authors believe that it follows from this that the rays detected by photographic means are not identical with those which produce electric discharges.

Magnetization and Modulus of Elasticity—The relations between magnetization and extension and between magnetization and torsion have been the subject of careful and fruitful researches. Those between the longitudinal elasticity and the magnetization have hitherto not been satisfactorily dealt with owing to the smallness of the effect. Herr K. Tangl's recent experiments, which have been published in the *Annalen der Physik* and digested in the London *Electrician,* do something to furnish us with consistent data. If a wire is magnetized under constant tension it changes its length. But if it is magnetized in such a manner that its length remains constant the tension varies. The ratio between the two alterations is proportional to the modulus of elasticity under the magnetization applied. This is the principle of the author's measurements. The results go to show that magnetization increases the modulus, as against the neutral results of Wertheim and Tomlinson. The change is about three per cent in iron for a field of a few hundred units, and about 1.5 per cent for nickel. As regards the extension under magnetization, Bidwell has already observed that the effect of loading is very much greater in nickel than in iron. This is all the more remarkable as the influence of loading in changing the modulus is greater in iron than in nickel.

Ions in the Atmosphere—Since the researches of Elster and Geitel have made it appear certain that free positive and negative ions exist in the atmosphere, Herr H. Ebert has attempted to arrive at a quantitative estimation of their number under different atmospheric conditions. His work is described in the *Physikalische Zeitschrift* and digested in a British contemporary. He employed an aspirator in which air is sucked through between the armatures of a charged cylindrical condenser, the potential being such that the potential gradient suffices to drive the ions to the sides within the time taken by any portion of the air-stream to pass through the condenser. In the apparatus described by the author, this time was one-seventh of a second, and the potential gradient would make an ion traverse the space between the armatures in one one-hundred-thirty-sevenths of a second, so that there is ample assurance of their interception. The results show that the number of free ions is very much larger in clear, sunny weather than in air filled with dust or moisture. The number is small in any case. The free charges in one cubic metre amount to about one electrostatic unit, or an amount which would be accounted for by the dissociation of 0.3×10^{-10} cubic cms. of hydrogen, or the dissociation of the 10,000 billionth part of the oxygen. This amount of ionization is about the 100,000th part of that produced by feeble Rœntgen rays.

Cathode Rays—The emission theory of these rays appears to be the prevailing one, at least in Germany. Herr W. Seitz has undertaken a study of the questions, what is the action between the emission particles and the material atoms or molecules in case that the latter can be considered at rest in comparison with the great velocity of the rays, whether one has to deal with frictional forces or conservative forces, and whether attraction or repulsion is exerted. The results of his work have been published in the *Annalen der Physik* and abstracted in the *American Journal of Science.* For the study of these questions there appear to be two ways open: The study of reflection and that of the phenomena presented by the passage of the rays through thin membranes. It was found that the cathode rays are diffusely reflected from metal surfaces connected to the earth. With aluminum, zinc, iron and copper, the maximum of intensity of the reflected rays was displaced toward the mirror. While with platinum, silver and gold, the reflection was strongest in a direction between that of the incidence ray and the normal to the metal surface. In the case of the first class of metals the reflection increases with the angle of incident; and with the last class diminishes. At perpendicular incidence the reflective power increases with the atomic weight. Zinc departs slightly from this law. The absorption of cathode rays in thin plates is independent of the tension. The absorption coefficient increases with the thickness of the window through which the rays pass. Lenard's law that thin plates of different metals, having equal masses per unit of surface, absorb the same fraction of the incident rays, is only a first approximation. The increase of the absorption coefficient, with the thickness of the window, can not be explained by the assumption that the electrons lose their velocity by friction with the molecules and are then absorbed, for no difference is observed between the magnetic and electric deflection of the rays in the case where they pass direct from the cathode, or in the case where they have passed through an aluminum window. Moreover, the rays emerging obliquely from the window behave in the same manner as those emerging along the normal to the window. The following values were obtained: $v = 0.703.10^{10}$; $\frac{e}{m} = 0.645.10^{7}$.

Electrochemical and Electrometallurgical Industry—III.

ARTICLE III: PROGRESS IN FRANCE.

By John B. C. Kershaw.

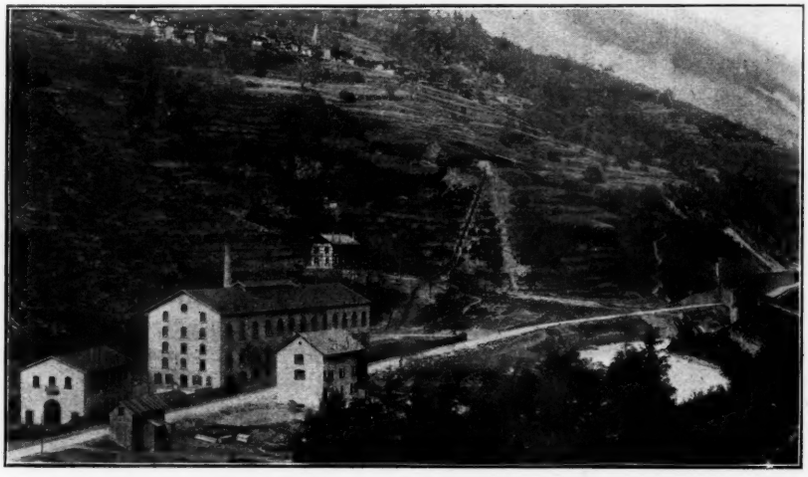
INTRODUCTION.

FRANCE is a country exceptionally favored as regards the supply of cheap power for electrochemical and electrometallurgical industries, and hence we find that a striking development of these new branches of manufacture has occurred in the eastern and southwestern departments of the country. The snows of the Alps and the Pyrenees feed a very large number of mountain torrents and rivers, which flow through the border departments of France to join the Rhone and the Garonne. In most cases the capital outlay involved in developing electrical energy from these tributaries of the two great rivers has not been excessive. The chief disadvantage connected with developments in these regions is that resulting from the great variations in the flow of water. In the spring and early summer, owing to the melting of the winter snows on the high Alps, the volume of water augments enormously—small streams become rivers of torrential violence—and immense quantities of detritus are brought down with the rush of water. In the winter and early spring, on the other hand, the flow of water is at a minimum. French hydraulic engineers have therefore had to overcome difficulties peculiar to their own country; and not only must detritus be provided for, but the maximum capacity of a power plant must be much in excess of its average yearly load. The capital outlay per average horse-power year is thus higher than in countries where the flow of water is subject to less variation, but in spite of this the cost of the electric horse-power year in certain power installations in these eastern provinces of France is remarkably low.

As a set-off to this cheapness of electric power there are the disadvantages due to the remoteness of many of the water-power installations from the main lines of communication with the markets for raw materials and finished products. This disadvantage has been especially marked in connection with the manufacture of calcium carbide, for in this case the cost of transport from the factory to the consumer often doubled the original cost of the manufactured product. In time, of course, the special difficulties caused by the distance of these new manufacturing districts in France from all the main avenues of trade and commerce will disappear. Branch lines of railway will be built to connect these remote valleys with the trunk lines, and the cost of transport for raw materials and finished goods will be reduced to a more normal figure. Already some transfer of trade and industry from the northern to the eastern and southern departments is apparent. This transfer will become more marked as the water-power developments in the latter districts are increased in number, for not only electrochemical but other manufacturing industries will gravitate to the districts where power can be most cheaply obtained. A recent enquiry has shown that eleven electrochemical and electrometallurgical works in France have 54,000 horse-power derived from water available for their manufactures. In the French Alps there are already located forty-eight factories, drawing over 150,000 horse-power from mountain torrents, and French engineers have estimated that this total is only one-twentieth of that which might be obtained from the streams and rivers of this eastern district. It is therefore probable that before the new century is far advanced France will be practically independent of foreign coal for power generation in her manufacturing industries, and that the provinces bordering upon the Alps and the Pyrenees will become the homes of busy and thriving manufacturing populations.

COPPER REFINING.

The electrolytic refining industry was founded in France about 1873 or 1874, as a result of the success of the original electrolytic refinery, at Pembrey, in South Wales. Three electrolytic refineries were in operation in 1875—at Marseilles, Biache and Paris, respectively—but the output of these was very small compared with that of more modern plants, and the largest of the three, namely, that of Eschger Mesdach & Company, at Biache, only produced about 1,400 pounds refined copper per day. The growth of the electrolytic refining industry in France was not rapid, and even in 1890 the output of five refineries was estimated by Fontaine to amount to only four tons per day,



General View of the St. Michel Electrolytic Chlorate Works, Savoy.

or 1,320 tons per annum. Since that date refineries at Pont-de-Cheruy and at Eguilles have been built, and works for the operation of the Elmore process have been started at Dives, near Havre. The latter factory is said to have a capacity of 200 tons of copper per week, but although financially it has been more successful than the English Elmore works, at Hunslet, it is doubtful whether it has ever yielded its maximum output for any lengthened period of time. In 1896 the daily production of the five French refineries was estimated to be only nine tons.

The French copper refining companies carry on their operations under the same difficulties as the English companies, and to the scarcity of raw copper suitable for refining by the electrolytic process is due

the lack of growth and development noticeable in the French industry. To such an extent has this affected the French refineries that in 1897 one of the oldest companies—"Societe Anonyme des Fonderies et Lammoirs," with works at Biache—was using its electrolytic plant chiefly for other work than copper refining, and in 1900 the output of refined copper at the Pont-de-Cheruy works of E. C. Gramont & Company only amounted to 150 tons.

The number of electrolytic refineries now operating in France is eight, but under the conditions which exist with regard to the supplies of raw copper, it would seem improbable that the French electrolytic refining industry can develop, and the use of the electrical plant and power in some of the existing refineries for other electrometallurgical manufactures would possibly lead to more remunerative results.

ALUMINUM.

The manufacture of aluminum by the electrolytic method was introduced into France in 1890, in which year a factory, with 800 horse-power (water) at command, was built and set in operation at Froges. The process used was that of Heroult. The competition of this works and of that erected for operating the same process at Neuhausen, in 1889, led to the shutting down of the two English aluminum factories at Oldbury and Patricroft (see Article II). In 1893 the "Societe Electrometallurgique Francaise," which carried on the manufacture under the Heroult process at Froges, built a second works at Le Praz, in Savoy, where 3,000 horse-power had been developed. The Froges plant a few years later was devoted to calcium carbide production, but the manufacture of aluminum by the Heroult process at Le Praz has continued down to the present time. The power plant at this works has now increased to 5,000 horse-power.

The rival aluminum works in France—namely, that at St. Michel—was likewise started in 1890, by Messrs. Bernard Brothers, of Paris. The process used was that patented by Minet. This differed from the Heroult and Hall processes in the composition of the electrolyte used in the pots or baths, a mixture of sodium chloride and cryolite being employed. In 1894 an agreement was signed between the representatives of the French and American patentees, and since that year the Hall process has been operated at this works.

Two thousand horse-power was originally used at St. Michel. This has been gradually increased, and 4,000 horse-power is now available for the manufacture of aluminum and other products at this place.

The company which originally owned the St. Michel works was known as the "Societe Industrielle de l'Aluminium," but the financial results were not satisfactory, and about three years ago the factory, with the adjoining power installation, was sold for £64,000 to the "Compagnie des Produits Chimiques d'Alais." This firm was formerly known as Pechiney & Cie., and they were the first manufacturers of aluminum by the older chemical process in France. This company still operates the Hall process for aluminum production at St. Michel, but the manufacture of other electrochemical and electrometallurgical products has also been commenced, and it is not known what proportion of the 4,000 horse-power available is being utilized for the original manufacture. No other works exist for the production of aluminum in France.

ELECTROLYTIC ALKALI WORKS AT GAVET-CLAVAUX, SAVOY.

As regards the output of the above two works no very reliable figures for recent years are available for publication. It is known that neither works is utilizing the whole of its power for aluminum production. According to the *Mineral Industry*, 763 tons aluminum were produced in 1899 by the two French works, but figures which have recently come into the writer's possession prove that this total is considerably below the actual output in 1900. The total power available—namely, 9,000 horse-power—corresponds to an annual production of 2,850 metric tons per annum, if an efficiency equal to that of the Hall process at Niagara be assumed.

CHLORATES OF POTASH AND SODA.

The manufacture of chlorates by the electrolytic method was commenced in France, at St. Michel, in 1894. The process used was that patented by Gall and Mortlaur, first operated at Villers-sur-Hermes, in Switzerland, in 1890, by the "Societe d'Electrochemie." The experimental plant at Villers-sur-Hermes having proved successful, larger works were erected in 1893 by the same company at Valorbes, in Switzerland, and at St. Michel, in France, and both these factories have been in regular operation down to the present time with satisfactory results to the shareholders in the French company.

The process used depends upon the electrolysis of a solution of potassium or sodium chloride, with platinum electrodes, in open cells (*i. e.*, without diaphragms).

Hypochlorate is first formed, as a result of the chemical reaction between the chlorine liberated at the anode and the hydrate formed at the cathode. This hypochlorate is then converted into chlorate by the heat, purposely produced in the cell, by the passage of the electric current through the electrolyte. The general principles of this method of chlorate production were fully described by Charles Watt in English patent No. 13,755, of 1851, and later patents only differ from this of 1851 in details of cell construction. About 4,000 horse-power (water) is available for this manufacture at St. Michel, and when devoted to potassium chlorate production alone, an output of 1,200 to 1,500 tons of this chemical per annum can be attained.

A second process for chlorate production is operated at Chedde in Haute Savoie, by Messrs. Corbin & Cie. In principle this resembles that of Gall and Montlaur, the chief distinction being in the method of mounting the platinum electrodes in the electrolytic vats. The Chedde works have been in operation since 1897,

and 12,000 horse-power (water) is stated to be available at this spot for electrochemical and electrometallurgical manufacture. Three-fourths of this power is now utilized in chlorate manufacture, and the output of the Chedde works in 1900 has been returned as equal to 4,500 tons. Both the St. Michel and Chedde factories are, however, producing other electrochemical products, and it is possible that the official figures given for the latter works represent *equivalent* rather than the *actual* output of potassium chlorate. Perchlorates and similar compounds of high oxygen value are now being produced at Chedde and other chlorate works by the electrolytic method.

As proof of the rapid growth of the electrolytic chlorate industry in France, it is interesting to note that in 1899 the *total output* of chlorate was estimated by Guillet to be 3,850 tons. To this total, the two older works contributed only 850 tons, while the two electrolytic works named above contributed 3,000 tons, or over seventy-five per cent.

CALCIUM CARBIDE.

The calcium carbide industry has developed to a greater extent in France than in any other European country. Although the patents relating to carbide production in the electric furnace were only granted in 1894, in 1899 there were in France twenty-one carbide factories in operation, and five others in course of erection. This rapid growth of the new industry was partly due to the fact that the production of calcium carbide in the electric furnace was held to be a French discovery—Moissan having read a paper on the production of metallic carbides early in 1894—and partly to the exaggerated ideas of the utility of the new product for illuminating purposes. As regards the question of priority for the discovery that calcium carbide could be produced in the electric furnace, limits of space will not allow any discussion of the rival claims of Borchers, Moissan and Wilson, but it must be admitted that Moissan, by his valuable and classic laboratory researches in 1893 on electric furnace reactions, laid a scientific basis for the new industry.

The French and foreign patents for carbide production were taken out in the name of Bullier, Moissan's assistant, and while the French patents have recently been upheld in the French courts, in Germany they have failed to stand a similar test, and are now quashed.

The value of patents for carbide production has, however, been largely discounted by the over-production and fall in price which have occurred in this industry, and many of the French carbide factories are now shut down or are employing their power for other manufactures. The collection of patent royalties in an industry in which half the firms are practically insolvent can be no easy task, and it is doubtful whether the syndicate owning the French Bullier patents for carbide production will make much profit before 1908, when the patents expire.

As regards the locality of the French carbide works, they are all operated by water power, and are scattered through the eastern and southwestern departments.

One of the first carbide furnaces was operated at Froges, where the old Heroult aluminum pots were adapted for carbide production, after the transfer of the aluminum manufacture to Le Praz. Other important carbide works exist at Bellegarde, La Bathie, N. D. de Briancon, Epierre, St. Bearon and Sechilienne; but it is impossible, owing to the depression in the carbide industry, to state to what extent the power available in these and the remaining seventeen carbide works in France is at the moment used for this manufacture.

A moderate estimate of the power available in these twenty-six carbide factories places it at 50,000 horse-power. France alone could therefore easily supply the present carbide requirements of the world.

ALKALI AND CHLORINE.

The manufacture of alkali and chlorine by the electrolytic method has not made very rapid progress in France, and the financial history of the various companies which have been formed to carry on the manufacture of these products is a somewhat tangled skein.

The St. Gobain Chemical Company, an old established chemical firm, with works at Chauny, near Paris, has been working the Hargreaves-Bird cell and process on a small scale since 1897, but although it has purchased the French patents, it has not yet increased the size of its plant. This delay, it informs me, is caused by the high price of coal. The company uses steam power.

In 1897 experimental trials were made at Modane, in Savoy, with a cell and process patented by Hulin. This process depended upon the use of fused salt as electrolyte with molten lead as cathode, and, therefore, was similar in principle to the Acker process now being tried at Niagara Falls. The trials at Modane were said to be successful, and in the same year the "Societe des Soudieres Electrolytiques" was formed to purchase the Hulin patents, and work the process at Les Clavaux, near Grenoble, where 5,000 horse-power was available. Manufacturing operations were commenced at this works in 1899 with 2,600 horse-power, but in 1900 the factory was shut down owing to financial and other difficulties. At the present moment further trials are being made with a modified form of the Hulin process, at Les Clavaux; the "Societe d'Electrochemie" (see "chlorates" above) being financially and technically interested in these new experiments.

The "Societe Industrielle des Produits Chimiques," a subcompany promoted by the "Elektron" Company, of Frankfort, in 1897, has been operating the latter company's process at Lamotte (Oise) since 1898, with 1,500 horse-power. The amalgamation between the German "Elektron" and "Bitterfeld" companies, details of which will be given in Article IV, has led to the promotion of a new company for France, the "Compagnie Generale d'Electrochemie," and the Lamotte works has now passed into the hands of this company. Another works is being built at Montiers by the "Societe Lyonnaise de l'Industrie Electrochemique" for operating a diaphragm cell patented under the name of Outhenin-Chalandre, and, therefore, it is possible that early in 1902 the number of electrolytic alkali works in France will be increased to four. Compared with the growth in the carbide industry progress has, however, been slow.

REMAINING INDUSTRIES.

The manufacture of perchlorates and other chemicals of similar composition by electrolysis has already been referred to (see chlorates).

Electric furnace work has already been a favorite study with engineers and chemists in France, and the fall in carbide values has caused owners of large water powers to experiment with the production of other electric furnace products.

The smelting of refractory ores and manufacture of alloys for use in steel works are, therefore, now engaging the attention of French electrometallurgists, and ferro-chrome, ferro-silicon and other similar alloys are being produced at Le Praz, Clavaux, Bozel and St. Michel. Details of the power utilized in this new industry are not available, but if a market can be found for the alloys produced it is one which will undergo great expansion.

The production of ozone by the silent electric discharge through air, and the use of this ozonized air for sterilizing water, for oxidization purposes in the manufacture of perfumes and for ageing wines and spirits, have received much attention in France. In only one case has a practical success been achieved; namely, in connection with the manufacture of heliotropine and vanillin. The Verley ozonizer is used in this works—situated at Courbevoie, near Paris—and 10,000 kegs of the two products named are produced per annum.

The experiments made with the Hermite sewage disinfecting process at Havre and Marseilles, about 1890, have not led up to any practical success. This process, in which electrolyzed sea-water was used, resembled the Wolff process tried at Havana in 1899, and failure in each case was due to excessive cost.

The electrolysis of brine, or solutions of common salt, for production of hypochlorite solutions is, however, carried on at a few textile works in France, and at Lancey, Isere, Messrs. Corbin & Cie. have a very large installation at work which supplies a bleaching liquid for their cellulose manufactory. In this case the cell used is not the Hermite, but one patented by M. Paul Corbin himself.

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—XIV.

BY A. E. DOBBS.

Referring again to Fig. 55 in the last chapter, it may be a matter of some interest to learn some of the details of a large installation of this kind. With this in view the writer took some measurements recently in the terminal room of one of the largest of the independent exchanges and which represents good construction with plenty of room to grow, there being room for 20,000 lines. The cables are fitted with carbon arresters and heat coils and are made to contain 102 pairs of wires, or 204 wires altogether, the exact size of the terminal being about as follows:

Length of terminal not including stems, fifty-four inches.

Width of terminal including arresters, etc., nine and five-tenths inches.

Space between terminals, six inches.

Height of cable from the false floor, fifteen inches.

Making a total height to top of cable, sixty-nine inches.

Twenty heads in a row occupy a running length of twenty-four feet six inches.

The method of fixing a framework for supporting this cable terminal is shown in diagram in Fig. 57.

The supporting frame is constructed of wrought steam pipe of two inches external diameter, through which holes are drilled at the proper intervals to allow the cable head to be bolted clear through the pipe. Two heads are then bolted back to back, two bolts at the top and two at the bottom holding both heads on the frame together. The lower pipe rests at intervals upon a short piece of pipe which passes into a foot-plate resting in cement about two feet six inches below. These supports are placed at intervals of five feet.

At the top support of the terminal there are placed two rows of the pipes, H S, connected together at intervals of five feet and supported by rods reaching to iron girders in the ceiling. They are also cross-connected at the ends and a couple of times in the centre, so that they make a pretty solid framework.

The arrangement of the cable terminals around the room is shown in Fig. 56, from which it will be seen that the framework could accommodate about 16,000 lines without crowding. Of these, one hundred heads are installed at the present time, while by crowding things a little it would be possible to place terminals for 25,000 lines in this room.

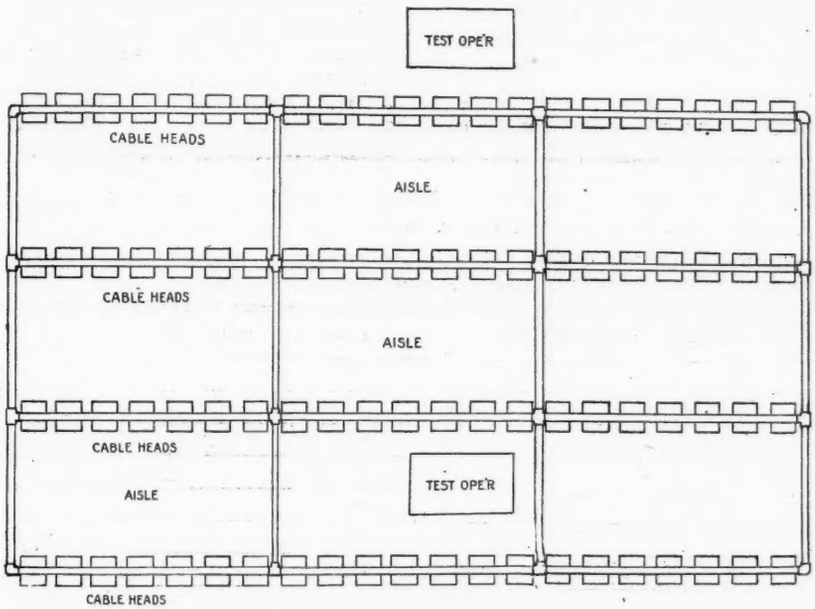


FIG. 56.—ARRANGEMENT OF CABLE TERMINALS.

As the cable head only contains 100 pairs, it is therefore necessary to split a 200-pair cable where one comes in from the outside, as is frequently the case, and divide it between two terminals.

The cables from the outside come underneath a false floor—raised about two feet above the regular cement floor—to the bottom of the terminals, while from the top they lead to the distributing board on the eighth floor, situated in a room adjacent to the switchboard. The false floor is made in short sections which fit closely together and which are laid on an iron framework so neatly that it is not easy to observe that all of this floor can be lifted up at will. The floor is scrubbed at intervals and carefully swept, and no debris is allowed to lie around except when a cable is being drawn in. Being heated by steam, there is very little moisture present in the room at any time. By means of bellows, dust is kept away from the terminal clips. As said before, terminals of this kind allow the use of much smaller distributing racks. It then becomes simply a matter of crowding a large number of clips closely together and soldering them on both sides. These clips are mounted on strips of hard rubber half an inch in width mounted on a strip of wood about an inch wide, each strip being about four feet in length and mounted vertically on the rack.

For convenience in counting, the clips are mounted on the rubber strips in sections of twenty pairs each, five such sections, of course, making a complete strip and also corresponding with the switchboard cables, which are also made in multiples of twenty pairs. A section of rack twelve feet in length can thus accommodate fifty such strips, or 5,000 metallic lines. These banks of strips are placed opposite each other at a distance of about two and one-half feet and are about six feet in height, so that a man can easily walk underneath the iron framework which supports the wires overhead.

One bank of these strips is connected to the cable and the other to the switchboard, the cross-connecting being done by passing wires on the framework overhead. Thus, for an exchange of 20,000 lines, there would be eight banks of strips, which would occupy a space a little more than twenty by twelve feet.

Of course, this is a large exchange, or it would not be necessary to build such a large framework in the terminal room, for if there were only ten or fifteen terminals they could be bolted to strips placed along the wall, which is the method usually followed in smaller exchanges, where both cables and distributing board are frequently placed behind or at the end of the switchboard.

It will also be noticed in Fig. 56 that there are placed outside of the main aisles two testing tables. These tables are equipped with instruments for locating trouble in a hurry and consist of two telephone sets and a low-reading voltmeter. When a trouble slip comes down from the operating room it is first handed to one of the test clerks—two of whom are at each table—whose duty it is to immediately have a test made at the terminal head to determine whether the trouble is outside the terminal toward the subscriber, or inside toward the switchboard. His first move is generally to signal the operator and receive her signals in return, which will set-

tle the case so far as that end is concerned. Then he tries to raise the subscriber, which test also determines as to whether the line is crossed, grounded or open outside. I neglected to state that the trouble slips first pass through the trouble clerk's hands, who has a record of every line on a card, something like that shown in Fig. 58. These cards are arranged alphabetically in a case, and the first thing

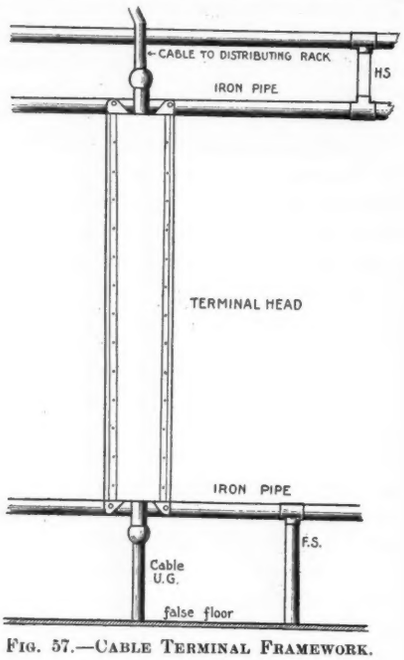


FIG. 57.—CABLE TERMINAL FRAMEWORK.

the clerk does is to take the card out of the case and note its cable number on a slip for the information of the test clerks and inspectors. Upon the return of this slip from the test clerks, the slip is then either passed up to the switchboard inspectors or the men outside, according to the report upon it.

As said before, the card is taken from the case and remains out as long as the trouble is in. It is placed back again when the trouble is cleared. By keeping these cards properly written up it is possible to keep a complete and accurate history of the line from the very beginning, as the card contains the subscriber's number, his location and business, the cable and the cable pair numbers and the location of the outside terminals. This information is also copied into a book kept for that purpose.

A record is also kept of all changes at the distributing boards, so that a wire can always be found at a moment's notice.

Reference has been made to a voltmeter on the testing clerk's desk. This is used to determine the presence of foreign current on the line, for, in a city that uses thousands of horse-power in the running of street cars, there is often current enough to throw the drop on the board, or, by opposing the signaling current, to prevent its being thrown, which the voltmeter indicates, and right here it might be whispered that the presence of twenty volts or more of street railway current is by no means uncommon and constitutes one of the most difficult problems with which the inspectors, as well as the engineering force, have to deal. In the centre aisle will also be seen a third testing table with a marble top, resting on four columns of brick, laid up with cement and resting in a bed of cement concrete below, and independent of the regular floor in order to prevent vibrations from any source.

This table is used to hold the finer testing instruments, which consist of a reflecting galvanometer, bridges, shunt coils, condensers and high-grade volt and ammeters for measuring the resistance, capacity and leakage of the cables.

The cable specifications call for an insulation resistance of 500 megohms to the mile, though, as a matter of fact, it is generally much higher than this, and a cable that shows an average insulation as low as that is looked upon with suspicion and frequently tested to see whether it becomes any worse.

The trouble clerk's room is immediately adjacent to the terminal room and contains a large card case for keeping records similar to that in Fig. 58. A pneumatic tube conveys trouble slips from the operating room above to the desk, where they remain till cleared, when they are sent back again to the proper department the same way.

All the outside inspectors report to the trouble clerk and receive their orders for the day and report again in the evening before going home. As fast as the various troubles assigned to the men are reported clear, they are marked down on the slip and sent to the bookkeeper upstairs. Every piece of wire or other material given to a repair man is charged to him, and when not in use is kept in that man's own locker, for which he holds the key—no two keys being alike—and in which he keeps his tools, clothing or other material needed. In making repairs, time and material are shown on the slip report.

In order to expedite "trouble hunting" and keep a better record of the work of the men, they are assigned to districts as much as possible, and each man is held accountable, to a great extent, for the condition of troubles in his district. When there is no trouble on hand, an inspector is assigned to general inspection work, with orders to report anything wrong that he may see. Thus a guyed pole may be giving way, throwing slack into the wires, or an electric light wire run dangerously close to the telephone lines, or the wires leading from a cable box be in a condition that will make trouble sooner or later, or there may be some tree trimming needed on certain portions of the line; all these things form the subject of special reports by the men and after that it is the fault of the construction and maintenance department if the matter is not attended to.

Form 57.
Tel. No. *M 1,201.* Cable *19.* Pr. *1.* Cir. *1.* Inst. *8/19.*
Location, *Ter. 1st E. Case Ave. Alley S. Payne.*
Subscriber, *George E. Bailey.*
Location, *618 Case.* Business, *Groceries.*

DATE.	TIME.	TROUBLE REPORTED.	DATE.	TIME.	TROUBLE FOUND.	"O K" BY.

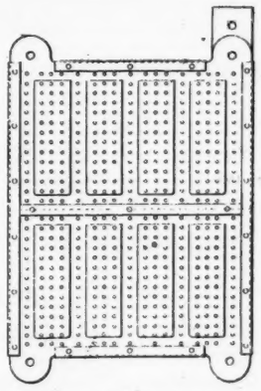
FIG. 58.—CARD FOR RECORDING TROUBLE REPORTS.

The men are also encouraged to make any suggestions tending to the improvement of the service in their districts, or to express any ideas they may have that will tend to reduce the trouble account. Their suggestions are treated with courtesy and consideration, no matter how foolish they may seem. This system also makes the men familiar with the location of cable boxes, pole numbers, subscribers and weak places in the pole lines, thus enabling them to clear away a great deal more trouble than if scattered all over the city at random.

The writer makes no apology for deviating slightly from the original purpose of these articles, which relate to small exchanges, to partially describe a big one, for large exchanges afford a profitable study to the smaller ones.

Electrical Patents

Mr. Thomas A. Edison, of Llewellyn Park, New Jersey, has patented a reversible galvanic battery. He utilizes metallic magnesium as the support upon which the zinc is electro-deposited when the battery is reversed after discharging. Magnesium standing higher in the electric series of active metals than zinc, obviously can not produce any action on the latter. Therefore, if an electric action did occur in the battery between the metals, it would necessarily affect the magnesium and not the zinc. However, in practice the magnesium is not attacked, but remains absolutely neutral. There is no local action between the two metals, and neither hydrogen nor zinc hydroxide is formed, as was the case with batteries of the type heretofore made employing zinc as the active material in an alkaline solution. With this battery the zinc is plated out of the solution upon the magnesium support in a dense and adherent form, and even with a large volume of current very considerable amounts of zinc can be thus deposited before the surface assumes a non-coherent character. He can not positively explain why the magnesium is not attacked and why local action does not take place thereon, as ordinarily magnesium is much more oxidizable than zinc. He believes, however, as the result of numerous experiments, that the phenomenon is satisfactorily explained by the supposition that the magnesium is coated with an extremely thin layer of oxide, insoluble in the liquid, and that the zinc is deposited upon the film of oxide and not upon the metal itself. If this supposition is correct, then the electric charges of the zinc ions apparently pass to the metal through this layer. In this improved battery he prefers to use copper oxide as the negative element. Finely divided copper is preferred, which is first moulded in form, then subjected to heat, so as to convert it into the black oxide, after which it is finally reduced to metallic copper by electrolytic action, so that in charging it will be reoxidized by the current to the red oxide (Cu_2O). The copper oxide so treated in the form of blocks or cakes of the desired size is preferably supported by perforated receptacles attached to nickel or nickel-plated plates. The solution employed is about a twenty per cent solution of caustic soda, to which zinc hydroxide is added until it is nearly saturated. The magnesium supports are in the form of thin plates, having numerous perforations therein and with the usual lugs at the bottom and top by means of which the plates may be assembled and electrically connected together. By employing numerously perforated magnesium plates the zinc deposit is more adherent, while at the same time the deposit is more evenly distributed over the entire surface than if the plates are imperforate, in which latter case a very much greater deposit takes place at the edges thereof than at any other point. The negative elements are formed of nickel or nickel-plated plates, carrying perforated nickel or nickel-plated pockets or receptacles, secured thereto, the plates being formed



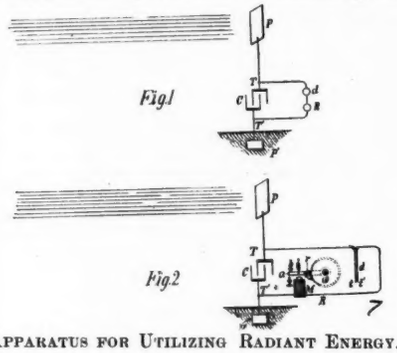
STORAGE BATTERY.

with lugs by which they may be assembled and electrically connected in the usual way. When the cell is in a neutral or fully discharged condition, the copper oxide plates or blocks will be reduced to the metallic state and the zinc will be in solution. In charging, the copper is oxidized and converted to the red oxide (Cu_2O), while the zinc is deposited electrically upon the magnesium electrodes. The charging is continued until about seventy-five per cent of the zinc in the solution is thus deposited, whereupon the cell is ready to be discharged. In discharging, obviously, the reverse operations take place, the copper oxide being converted to the metallic state and the zinc going back into the solution. The voltage of this battery is 0.67 volt. In discharging it will be found that a point is reached where the voltage falls considerably, due to the approach to exhaustion of the oxygen in the copper, and the discharge should not be permitted to take place materially beyond that point. The positive and negative elements are properly connected and are supported in a suitable enclosing jar, hermetically sealed from the air, the jar being provided with a vent for the escape of any gas generated therein. In another battery, patented at the same time, he employs an alkaline zincate solution, an electrode of metallic magnesium upon which the zinc is deposited during the charging operation, and a second electrode carrying as the depolarizing material an electrolytically-active oxide of nickel or cobalt, preferably intimately mixed with a flake-like inert conducting material, such as flake graphite. Cobalt is not considered as desirable for use as nickel owing to its greater cost and to the fact that it is slightly soluble in an alkaline electrolyte. The electrode for supporting the depolarizing material is made, preferably, of sheet steel carefully nickel-plated so as to be unattacked by the alkaline solution, and provided with pockets or receptacles having perforated walls and within which the depolarizing material is maintained under pressure, so as to be at all times in good electrical contact with such walls, said pockets or receptacles being made of very thin nickel-plated sheet steel high in carbon, so as to be sufficiently elastic to accommodate changes in bulk of the active material.

Herr Arthur Lehmann, residing in Berlin, Germany, has also obtained a patent in this country on a new process for preparing secondary battery plates, the object of the invention being to shorten the time required for the production of the plates. "The lead electrodes coming from the founding machine are made to show a chemically pure metallic surface, for which purpose brushes or a jet of sand-blast are used. These plates are then conveyed into a bath containing a solution of an organic acid. The acid can be palmitic acid, stearic acid, oxalic acid, lactic acid, etc., or any one of the fatty acids. In this bath the electrodes are exposed to an electric current for a certain length of time. In this bath, under the action of the electric current, the plates are rendered more receptive and the surface is increased similar to ribbed plates. The reactions taking place are for the application of oxalic acid ($C_2O_4H_2$). The acid decomposes under the influence of the electrical current, and C_2O_4 combines with Pb to C_2O_4Pb (oxalate of lead). When carbonate of sodium is added to the oxalic acid, there is formed first from $C_2O_4H_2$ and Na_2CO_3 $C_2O_4Na_2CO_2H_2O$. From the oxalate of sodium $C_2O_4Na_2$ there takes place another separation into Na_2 and C_2O_4, the latter combining with Pb. It has been found that the lead electrodes are attacked more intensely in the bath containing an organic acid if the acid solution in the bath is neutralized or made alkaline by the addition of carbonate of sodium. After the current has been

passed through the solution the alkaline solution becomes acid, and it is thought that the organic acid employed is more effective in the nascent state. From the deep coloring of the positive plates can be judged whether the plates have been attacked sufficiently. In that case the plates are removed, washed in running water, and then hung up in a bath containing lye of caustic soda. After the plates have been exposed to the lye of caustic soda for a certain time they are again washed in running water and dried, so that nothing remains of the organic acid used to attack the plate and to make it a conductor. For the further formation of accumulators sulphuric acid can be used. In the sulphuric acid the plates are then exposed to the electric current for about fifty hours, and they can then be considered ready for use."

Another patent has just been issued to Mr. Nikola Tesla, the present invention relating to apparatus for the utilization of what the inventor calls radiant energy, such as the sun's rays and the like. It is well known that certain radiations—such as those of ultra-violet light, cathodic, Rœntgen rays, or the like—possess the property of charging and discharging conductors of electricity, the discharge being particularly noticeable when the conductor upon which the rays impinge is negatively electrified. These radiations are generally considered to be ether vibrations of extremely small wave-lengths, and in explanation of the phenomena noted it has been assumed by some authorities that they ionize or render conducting the atmosphere through which they are propagated. Mr. Tesla's experiments and observations, however, have led him to conclusions more in accord with the theory heretofore advanced by him that sources of such radiant energy throw off with great velocity minute particles of matter which are strongly electrified, and therefore capable of charging an electrical conductor, or, even if not so, may at any rate discharge an electrified conductor, either by carrying off bodily its charge or otherwise. The present invention is based upon a discovery, which he claims to have made, that when rays or radiations of the above kind are permitted to fall upon an insulated conducting body connected to one of the terminals of a condenser while the other terminal of the same is made by independent means to receive or to carry away electricity, a current flows into the condenser so long as the insulated body is exposed to the rays, and under the conditions hereinafter specified an indefinite accumulation of electrical energy in the condenser takes place. This energy, after a suitable time interval, during which the rays are allowed to act, may manifest itself in a powerful discharge, which may be utilized for the operation or control of mechanical or electrical devices or rendered useful in many other ways. In applying this discovery Mr. Tesla provides a condenser, preferably of considerable electrostatic capacity, and connects one of its terminals to an insulated metal plate or other conducting body exposed to the rays or streams of radiant matter. It is very important, particularly in view of the fact that electrical energy is generally supplied at a very slow rate to the condenser, to construct the same with the greatest care. He uses, by preference, the best quality of mica as dielectric, taking every possible precaution in insulating the



Apparatus for Utilizing Radiant Energy.

armatures, so that the instrument may withstand great electrical pressures without leaking, and may leave no perceptible electrification when discharging instantaneously. Obviously, the above precautions should be more rigorously observed, the slower the rate of charging and the smaller the time interval during which the energy is allowed to accumulate in the condenser. The insulated plate or conducting body should present as large a surface as practicable to the rays or streams of matter, he having ascertained that the amount of energy conveyed to it per unit of time is under otherwise identical conditions proportionate to the area exposed, or nearly so. Furthermore, the surface should be clean and preferably highly polished or amalgamated. The second terminal or armature of the condenser may be connected to one of the poles of a battery or other source of electricity or to any conducting body or object whatever of such properties, or so conditioned that by its means electricity of the required sign will be supplied to the terminal. A simple way of supplying positive or negative electricity to the terminal is to connect the same either to an insulated conductor supported at some height in the atmosphere or to a grounded conductor, the former, as is well known, furnishing positive and the latter negative electricity. As the rays or supposed streams of matter generally convey a positive charge to the first condenser terminal, which is connected to the plate or conductor above mentioned, the second terminal of the condenser is usually connected to the ground, this being the most convenient way of obtaining negative electricity, dispensing with the necessity of providing an artificial source. In order to utilize for any useful purpose the energy accumulated in the condenser, there is furthermore connected to the terminals of the same a circuit including an instrument or apparatus which it is desired to operate and another instrument or device for alternately closing and opening the circuit. This latter may be any form of circuit controller, with fixed or movable parts or electrodes, which may be actuated either by the stored energy or by independent means. The discovery will be more fully understood from the accompanying drawings, in which Fig. 1 is a diagram showing the general arrangement of apparatus as usually employed. Fig. 2 is a similar diagram illustrating more in detail typical forms of the devices or elements used in practice. As illustrative of the manner in which the several parts or elements of the apparatus in one of its simplest forms are to be arranged and connected for useful operation, reference is made to Fig. 1, in which C is the condenser, P the insulated plate or conducting body which is exposed to the rays, and P′ another plate or conductor which is grounded, all being joined in series, as shown. The terminals T T′ of the condenser are also connected to a circuit which includes a device R to be operated and a circuit-controlling device *d* of the character above referred to. The apparatus being arranged as shown, it will be found that when the radiations of the sun or of any other source capable of producing the effects before described fall upon the plate P an accumulation of electrical energy in the condenser C will result. This phenomenon is best explained as follows: The sun, as well as other sources of radiant energy, throws off minute particles of matter positively electrified, which, impinging upon the plate P, communicate continuously an electrical change to the same. The opposite terminal of the condenser being connected to the ground, which may be considered as a vast reservoir of negative electricity, a feeble current flows continuously into the condenser, and inasmuch as the supposed particles are of an inconceivably small radius of curvature, and consequently charged to a relatively very high potential, this charg-

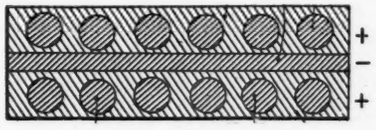
ing of the condenser may continue, as has been actually observed, almost indefinitely, even to the point of rupturing the dielectric. If the device *d* be of such character that it will operate to close the circuit in which it is included when the potential in the condenser has reached a certain magnitude, the accumulated charge will pass through the circuit, which also includes the receiver R, and operate the latter. Fig. 2 is an illustration of a particular form of apparatus which may be used in carrying out the discovery. In this figure, which in the general arrangement of the elements is identical to Fig. 1, the device *d* is shown as composed of two very thin conducting plates *t t'*, placed in close proximity and very mobile, either by reason of extreme flexibility or owing to the character of their support. To improve their action they should be enclosed in a receptacle from which the air may be exhausted. The plates *t t'* are connected in series with a working circuit, including a suitable receiver, which in this case is shown as consisting of an electromagnet M, a removable armature *a*, a retractile spring *b*, and a ratchet-wheel *w*, provided with a spring pawl *r*, which is pivoted to armature *a*, as illustrated. When the radiations of the sun or other radiant source fall upon plate P, a current flows into the condenser, as above explained, until the potential therein rises sufficiently to attract and bring into contact the two plates *t t'* and thereby close the circuit connected to the two condenser terminals. This permits a flow of current which energizes the magnet M, causing it to draw down the armature *a* and impart a partial rotation to the ratchet-wheel *w*. As the current ceases the armature is retracted by the spring *b*, without, however, moving the wheel *w*. With the stoppage of the current the plates *t t'* cease to be attracted and separate, thus restoring the circuit to its original condition.

Mr. Noble Jones, a resident of Sparrows Point, Md., has just obtained a patent on a fuse cutout which he claims will ordinarily prevent the arcing when the fuse is melted and, in any event, will confine the fire due to arcing should it occur to the fuse box or block. A fuse box is made in the ordinary manner, comprising a porcelain body having binding-posts, to which the line wires are attached, a pair of the posts carry clamping screws to which the ends of the fuse wires are secured. Located contiguous to, but insulated from, the other posts are other clamping screws to which the opposite ends of the fuse wires are secured. The novel feature of the invention resides in a pair of magnets arranged in suitable sockets in the block, one of the magnets being disposed beneath each fuse wire. The cores of these magnets are of soft iron, and are wound with wire of a gauge suitable to the current passing through the block. These magnet wires are each connected at one end with one of the insulated clamping screws and at the other

MAGNETIC FUSE CUTOUT.

with the corresponding binding-post, so that the magnets are in series with the fuse wires. When the current becomes excessive, and sufficient to cause the fuse to melt, the arc thus formed will be blown out or extinguished by the action of the magnet arranged directly beneath it. Thus all danger of fire from this cause is removed, the effect being produced by the magnetic field established above the magnet and to which the fuse is exposed.

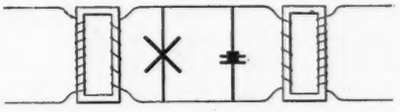
M. Paul Chapuy, residing at Vincennes, France, has just obtained a patent in this country on a novelty in the line of electric batteries. He provides a body composed of some porous material that resists the action of the electrolyte, and in this body embed the positive and negative elements, which are insulated from each other by the body. These bodies he describes as being formed of pure clay or kaolin and of a flux, the whole being compounded with coal, carefully sifted to the required size and free from impurities or ashes. The



ELECTRIC BATTERY.

ingredients are crushed and mixed in a mill, then moulded into the requisite forms and dried, after which they are baked at a temperature exceeding 1,200 degrees centigrade. This burns out the coal, leaving a porous structure. The cavities for the reception of the electrodes may be formed in the blocks or bodies, while they are being made or after they are completed.

A telephone relay has been patented by Herr Bela Gati, of Temesvar, Austria-Hungary. It consists, in general, in causing the telephonic currents to modify the current feeding the arc of an arc lamp, thus causing the lamp to magnify such modifications and transferring such magnified modifications of current by induction to another circuit containing telephonic receiving apparatus. A transformer or induction coil is provided, the primary winding of which is in the transmitting circuit. The secondary winding of this induction coil is located in a circuit which includes the generator and an arc lamp, as well as the primary winding of another induction coil. The wires lead to a telephone receiver, and they include the secondary winding of the second induction coil. The arc lamp is preferably of the continuous-current type, requiring about forty-five volts electro-motive force and from three to ten amperes. The function of the generator is to supply the normal arc in the lamp. The operation is as follows: The weak telephonic currents traversing the transmitting circuit act by induction upon the lamp circuit, causing



TELEPHONE RELAY.

corresponding increases and decreases of current therein. An increasing impulse of current will cause the carbons of the lamp to approach each other, which will result in a corresponding decrease of resistance in the lamp circuit, and, according to Ohm's law, this decrease in resistance will result in an increase of current from the generator. This resulting increase of current will be much greater than the impulse from the telephonic circuit which originated it or was responsible for it, and this amplified current, flowing in the circuit-connecting generator and lamp, will correspondingly affect the second induction coil and send out to the receiving telephone in the circuit a much stronger impulse than was created by the voice in the transmitting circuit. Likewise every impulse traversing the transmitting circuit affects the arc in the lamp and is proportionately magnified by the lamp and sent out onto the receiving circuit through the second induction coil. Lesser impulses act with less effect upon the arc, and a wider difference takes place in the second induction coil.

The Canadian Electrolytic Company, of Montreal, Quebec, has applied for incorporation to manufacture salt, lime, soda, etc. Its capital stock is $300,000. Among the applicants are Mr. Harry Bates, of Boston, Mass., and Mr. Walter Mitchell, of Montreal.

THE ELECTRIC TRANSMISSION OF POWER FROM NIAGARA FALLS—VII.

BY LEWIS B. STILLWELL.

In aiming to secure satisfactory automatic control and separation of circuits in case of accidents, as I have said, the time element relay circuit-breaker was introduced for the purpose of localizing trouble by cutting off the branch circuit affected without interfering with continuity of service through other branches, or supplied through the same trunk lines. In addition to this, the reversed current circuit-breaker was installed at the Buffalo end of the line for the purpose of automatically disconnecting from other circuits in that city any one of the overhead transmission circuits from Niagara which might become short-circuited. Reversed current circuit-breakers, I believe, were first used in Hastings, England, where they were connected in the circuit between alternators and bus-bars. Those which have been used in connection with the Niagara plant consist essentially of a circuit-breaker similar to those used for opening circuits under abnormal overloads, excepting that the usual tripping coil is omitted and a tripping device actuated by reversal of current substituted. In one type, the tripping device is simply a motor, one element of which is energized from and is consequently approximately in phase with the bus-bars, to which two or more incoming circuits are connected, while the other element is connected into and is therefore in phase with the current traversing the circuit, which, under certain conditions, it is intended to open. In another type, and one which is probably more certain in action because less affected by the radical displacement of phases which accompanies short-circuits, the elements of a Shallenberger meter are used, the disc normally tending to rotate in a given direction, but being held by a stop when the current through the series element is normal. In case of a short-circuit on the line, the direction of current through the series coil is momentarily reversed, while that through the shunt coil, which is connected to the bus-bars, though shifted in greater or less degree, remains in phase with the incoming circuit, which has not been short-circuited; consequently, the disc tends to rotate in an opposite direction, and, being free to move, revolves through a certain angle and closes an auxiliary circuit which opens the breaker. In three-phase circuits the connections are complicated, and, owing to the radical displacement of phases which occurs when lines are short-circuited, I regard none of these devices as thoroughly reliable, although they have sometimes acted satisfactorily.

X—TRANSMISSION AND DISTRIBUTION.

In the report of Professor W. C. Unwin, secretary of the International Commission, which, in January and February, 1891, considered no less than twenty-two plans for the development of Niagara power, which had been submitted in compliance with an invitation from the Cataract Construction Company, it is stated that: "There were two or three points of primary importance as to which the commission came to a definite expression of opinion." One of these related to the distribution of power by electrical conductors, and the language of the secretary's report is as follows:

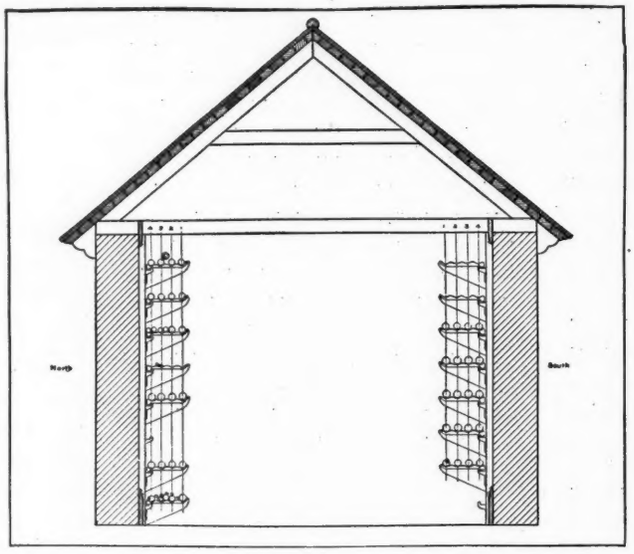


FIG. 14.—CROSS-SECTION OF BRIDGE CONNECTING POWER-HOUSE WITH TRANSFORMER-HOUSE.

On a third point the commission came to a conclusion which departed from the view taken by any of the competitors. They considered that it would be necessary to have a tunnel, or subway, in which to place the main electrical distributing conductors; in such a subway the conductors could be of bare copper, placed on insulators. If the conductors were so placed in a subway, the greatest facility would be afforded for erection, for repairs, for inspection and for cleansing and there would be the greatest security from accident due to lightning or rain or snow, or to provide against public wanton mischief. These considerations appear to the commissioners to be so important that they would justify the excessive cost involved in the construction of the subways, which, however, would probably not be great.

Beyond doubt, such a subway, if large enough to admit of proper spacing of bare conductors carrying 20,000-volt currents and supported upon porcelain or glass insulators, would possess the advantages pointed out by the commission; but, unfortunately, its cost is so great as to be quite prohibitive, unless the power transmitted through it is very large in amount—*e. g.*, 50,000 kilowatts. However, at the outstart the company actually did construct a tunnel, or subway, about half a mile in length, extending from the power-house to a point near the works of the Pittsburgh Reduction Company.

This tunnel was designed by Professor Forbes and has been fully described by him in his paper of November, 1893. He proposed to use bare copper conductors supported upon porcelain insulators and carrying 20,000 volts for both local and long-distance work, but the alternators finally adopted being wound for 2,200 volts, the subway has never been used as originally expected.

Quite apart from considerations of cost, its dimensions are too restricted, in my opinion, to permit satisfactory working with bare conductors at any such potential as 20,000 volts, but setting aside the question of practicability, its actual cost exceeds by not less than $50,000 a mile the cost of a pole line such as that erected by the company last year. At the present time, exclusive of the power used temporarily for lighting the Pan-American Exposition, about 12,000 kilowatts are delivered in Buffalo at time of maximum load. The cost of a tunnel from the power-house to the new terminal-house in Buffalo, a distance of 223 miles, would exceed the cost of the new pole line by not less than $1,200,000 and the increased investment required, upon the basis of present business in Buffalo, would approximate $100 per kilowatt delivered at time of minimum local. On the basis of 3,000 kilowatts delivered, the difference in cost of tunnel and pole line would of course be $400 per kilowatt delivered, and since at the outstart the company was able to contract only for some 3,000 kilowatts in Buffalo, the reason why the directors decided to use overhead construction instead of a subway is sufficiently obvious. It is to be noted that the commercial feasibility of

a subway for electrical conductors depends primarily upon the amount of power transmitted. Had it been possible at the outstart to contract for the sale of 30,000 kilowatts in Buffalo, a subway might have been commercially feasible, but even then to allow not only for proper spacing of the cables, but for convenient and safe inspection and maintenance, it should have been made considerably larger in section than was the case with the comparatively short length actually constructed, and this of course would have made it still more expensive. For local distribution, with its branch lines and ramifications, such a subway construction is entirely unsuitable. In 1893 cables that could be relied upon for working under 10,000 volts potential could not be procured and the company's decision to adopt an overhead construction for transmitting power to Buffalo was the only one justified by the state of the art. Since that time, manufacturers of cable have realized great improvement in quality and effected radical reduction in cost and coincidently with these changes the sale of power in Buffalo has steadily increased. It is expected, therefore, that the day will come when underground cables will be employed for this transmission.

The Local Distributing System—With the details of the early evolution of the local system of distribution used by the company I am not familiar. In March, 1897, power was supplied to local tenants, whose works for the most part were located upon the land of the Power company, in amounts approximately as follows:

The Pittsburgh Reduction Co.	3,195 E.H.P.
The Carborundum Co.	1,000 E.H.P.
Acetylene Light, Heat and Power Co.	1,000 E.H.P.
Niagara Electro-Chemical Co.	400 E.H.P.
Buffalo & Niagara Falls Electric Light and Power Co.	500 E.H.P.
Buffalo & Niagara Falls Electric Railway	300 E.H.P.
Niagara Falls & Suspension Bridge Railway Co.	250 E.H.P.
The Niagara Falls Water Works Co.	45 E.H.P.
Hygeia Ice and Refrigerating Co.	40 E.H.P.
The Cataract Power and Conduit Co.	1,000 E.H.P.

The power used by the railways was delivered in the form of direct current at about 570 volts, three 500-horse-power rotary converters with step-down transformers having been installed inside the power-house for this purpose. With this exception, the entire output of the plant was conveyed through single-conductor cables of 1,000,000 c.m. section from the bus-bars of "switchboard No. 1" through the subway and bridge connecting the power-house with the transformer-house. A cross-section of the bridge is shown in Fig. 14.

In the transformer-house, those cables used for the long-distance service were connected to the step-up transformers while beyond the transformer-house power was conveyed to local tenants through single-conductor lead-covered cables, the majority of which were of the section above mentioned.

There was no provision in the way of conduits for the cables which extended from the manhole at the end of the tunnel to the works of the Mathieson Alkali Company, the Niagara Electro-Chemical Company and the Niagara Electric Construction Company. The cables leading to these works had simply been laid upon the top of the ground and extended across the fields to the several establishments supplied with power.

Naturally these cables, although not extending outside the limits of the company's property, were subjected from time

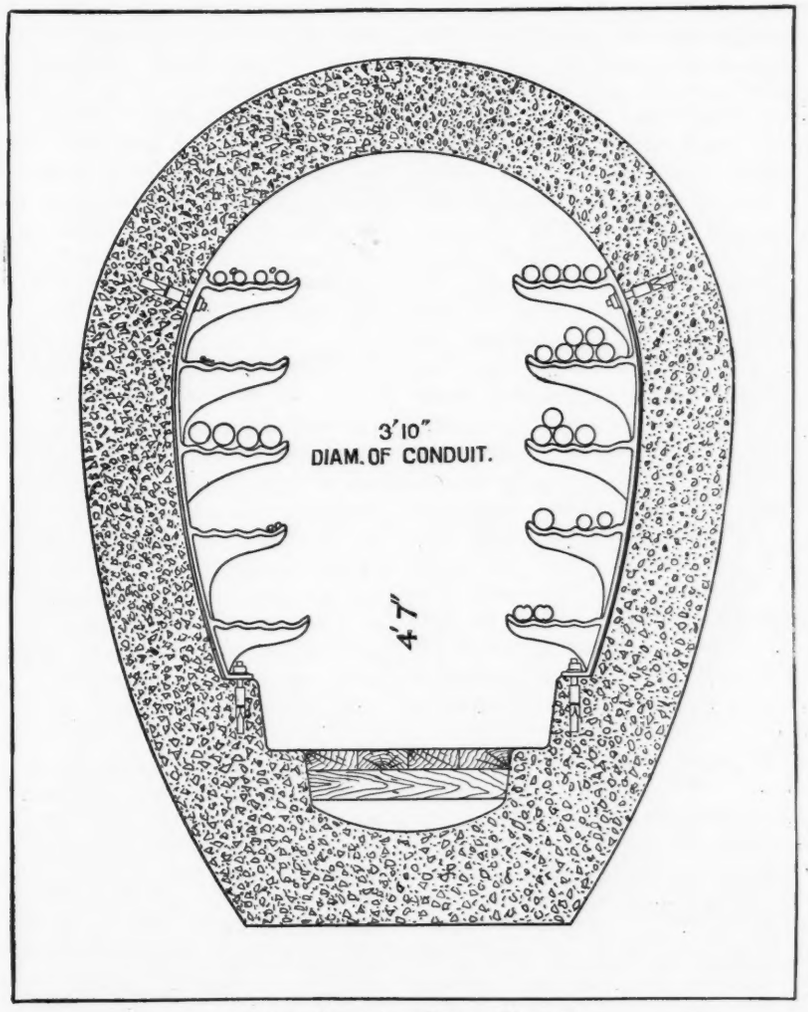


FIG. 15.—SECTION OF FORBES SUBWAY.

From the transformer-house to a manhole near the works of the Pittsburgh Reduction Company these cables were carried through the subway tunnel, to which I have referred.

Iron brackets had been erected on each side of the tunnel at intervals of five feet and upon these a majority of the lead-covered cables were supported, although some of them had been simply drawn into the tunnel and rested upon the floor. A cross-section as shown in Fig. 15.

to time to mechanical damage by reason of carelessness and malicious mischief, and the local service was considerably interfered with. The work of reconstructing and extending the local distributing system was therefore taken up and pushed to a conclusion, the system now used, except the subway, being second to none. As evidence of this, it may be mentioned that for the last two years interruptions of the local service, even momentary in duration, have been extremely rare. A

brief description of the steps taken to effect this result may be interesting.

Pending the completion of proper conduits, these cables beyond the end of the tunnel were placed temporarily in wood boxes for mechanical protection, and following this tile conduits were constructed.

For the double purpose of effecting removal from these boxes of the cables in use without interruption of service to the tenants and providing an alternative set of cables to the works of each tenant to be promptly substituted for the usual working cables in case of breakdown, the company put down four 1,000,000 c.m. spare cables, making connections from these to the works of each of the tenant companies, which could be reached thus without prohibitive expense. In the works of each tenant company to which this relay cable was extended four two-way, double-blade, single-pole switches, suitably mounted, were installed, the spare cable being connected to one set of terminals, while the cable ordinarily used by the tenants was connected to the other set of terminals. The leads from these switches to the electrical apparatus of the tenant company were connected to the middle points of the two-way switches.

The double-blade switches were so constructed as to permit either of the two blades to be independently transferred from one contact to the other, thus making it possible to supply the tenant from the cable ordinarily used from the spare cable or from both at the same time. This arrangement is now in use, and is very effective. For purposes of testing or for transfer from one cable to the other in time of emergency, and for testing purposes the switches are most useful.

From the end of the cable tunnel, a thirty-six-duct conduit was put down extending to a manhole on Adams avenue, immediately north of the works of the Mathieson Alkali Company. Section of this conduit is square, the three-inch tile ducts being laid in six horizontal rows, each comprising six ducts. It is laid upon four inches of concrete and protected on the sides by two inches and on the top by about three inches of concrete.

During the summer of 1899 it became necessary to provide conduits and cables to connect the power-house with the new works of the Union Carbide Company, which are located on the land of the Power company, at a distance of about two and one-quarter miles from the power-house, and it was decided to put down a trunk conduit having a number of ducts sufficient to provide not only for the Carbide company, including its contemplated extensions, but also for other tenants who in future may locate in the same vicinity. For the Carbide company immediate provision was to be made to the extent of 15,000 horse-power with necessary spare cable.

The use of power by the Carbide company, and by the majority of the tenants of the Power company, does not vary from hour to hour between wide limits, as is usual in lighting or railway service, but remains almost constant. This fact, in connection with the very large amount of power for which provision had to be made, led to careful consideration of the subject of heat in the conduits and its probable effect upon the cables. Prior to this, my attention had never been particularly directed to the question of heat in conduits, but upon consideration it was at once obvious that the usual construction of a conduit comprising a considerable number of ducts is admirably adapted to prevent the dissipation of heat caused by the currents traversing the cables.

A New Ferry Steamboat for the Intercolonial Railway.

A new ferry steamboat to be used in the Strait of Canso has been built by the Sir William Armstrong, Whitworth & Company, Limited, at Walker shipyard, Newcastle-on-Tyne, for the Intercolonial Railway, of Canada. She has been named the Scotia and is a double-screw boat, built on special lines, one screw at each end. She is 282 feet in length, 48 feet in width and 17 feet in depth. Her draft is about 12 feet, and she is capable of carrying nine passenger cars at one time, or 18 freight cars, at a speed of 12 miles an hour. She has triple-expansion engines—cylinders, 17½ by 28 by 45—27-inch stroke; four horizontal boilers, carrying 160 pounds of steam, with a smoke-stack to each boiler, and her engine capacity is 2,000 horse-power. The engines were built by the Wallsend Shipping and Engineering Company, Limited, Wellsend-on-Tyne. The gross tonnage of the steamer is 1,461.20 tons, and her registered tonnage 324.26. The Scotia was built for summer and winter service as a car ferry, and has a specially strong frame at the water line to enable her to battle with the ice in the winter season. She is fitted up with electric lights throughout and a searchlight.

The Trans-African Telegraph.

The report recently issued by the British South African Company contains much of interest to engineers, says *Engineering*. The work being done on the transcontinental line appeals in a special degree to the imagination. The adventurous servants of the company had, at the date of the report, carried the line up to the southern shore of Lake Tanganyka, and thence into German territory; the total length erected during the year being 325 miles. At the end of the previous season the line had reached Karonga, near the northern extremity of Lake Nyassa. From this point to Lake Tanganyka is a distance of nearly 200 miles, in the course of which a "divide" has to be crossed. For the first 40 miles the road is quite impracticable for wheeled traffic, and all transport had to be effected by carriers. Smallpox broke out among these and they deserted in thousands. Further on the road proved easier, but required to be almost entirely remade, and many drifts had to be constructed across the rocky beds of streams. Some trouble has been experienced in maintaining certain sections of the line previously completed. The 67-mile section from Chiromo to Chikwawa passes through a large marsh in which the vegetation grows to such a height during the wet season as to top the wire, thus causing great loss by leakage. The natives can not be persuaded to cut down the grass and trees, as the place swarms with crocodiles. In the next section the line passes through a thick forest, and as no proper clearance was made at the outset, constant watchfulness on the part of the patrols has been necessary to prevent serious interruption from falling trees. In the section from Zomba to Fort Johnson the elephants caused an interruption by breaking off poles. In the sections immediately following, the line passes through marshes and forests. Some of the trees met with were enormous, one specimen measuring over 100 feet in circumference. This district is stated to be most unhealthy in the rainy season, and it is difficult then to repair faults, as most of the track is under water. In the rough country following these belts of marsh and forest the line has had to be carried over numerous gorges and ravines in spans of from 200 to 300 feet. These ravines are impassable to linesmen in the rainy season, but plant is now being provided to cope with this difficulty.

It is said that experiments with the Delany telegraph system will be carried on by the Pennsylvania Railroad. With this system, which was described in the ELECTRICAL REVIEW of September 28, 1901, it is possible to transmit 8,000 words a minute, while a commercial rate of 2,000 words a minute is said to be possible with a single copper wire. With this system perforated tape is used, the characters being recorded electrolytically on tape which has been chemically prepared.

REGULATING DEVICES FOR SERIES ALTERNATING CURRENT CIRCUITS.*

BY J. HENRY HALLBERG.

The adaptability of the series alternating-current arc lamp, for street and

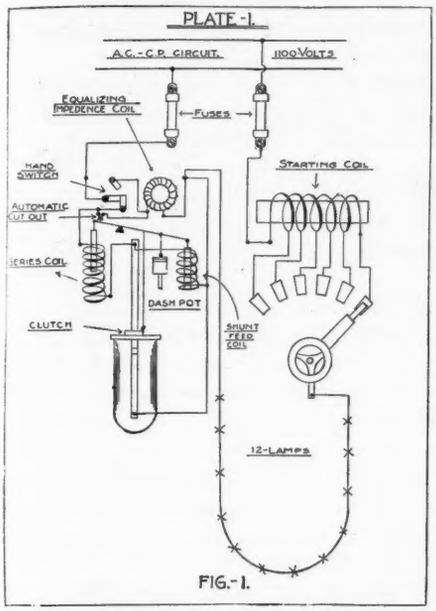


FIG. 1.—SERIES ALTERNATING-CURRENT ENCLOSED ARC LAMP SYSTEM, SHOWING HAND-OPERATED STARTING COIL.

commercial lighting, is now generally admitted, and the subject has already been so ably discussed that it will be unnecessary for us to, more than in a general way, consider the qualities of the alternating-current enclosed arc as compared with other sources of illumination.

The writer will, therefore, devote this paper to a general description of regulating apparatus and enclosed arc lamps for series alternating-current circuits, and a practical description in detail of the series alternating-current enclosed arc system, using the reactive coil and shunt-wound arc lamp.

There are at the present time in practical use three different methods of control for series alternating-current enclosed arc lamps; so distinct as to constitute types.

METHOD NO. 1.

A system employing a differentially wound arc lamp, equipped with an automatic cutout and hand-switch, which cut in or out an arc-equalizing impedance coil.

A number of these lamps may be connected in series directly across a constant-potential alternating-current circuit, provided the potential required by the lamps is about the same as the potential on the constant-potential circuit. This system is shown in Fig. 1. This method of operating arc lamps in series and the general design of the lamp is practically the same as when lamps are operated in series on a constant-potential, direct-current circuit, such as a 500-volt power circuit, for instance, the only difference in the lamps being that the cores and coils are designed for alternating current and in place of a dead resistance a reactive coil is cut into the circuit when the lamp is cut out by the hand-switch, or if it should cut itself out automatically. It will be readily seen that such a system does not allow for increase or decrease in the number of lamps on the circuit, and also that in case of a double ground, or short-circuit, the fuses will blow and all the lamps will go out.

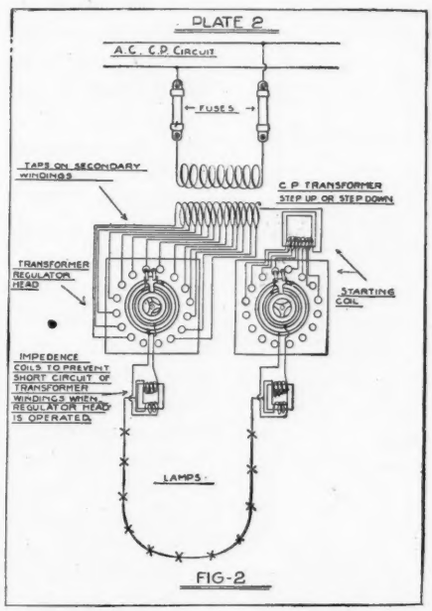


FIG. 2.—MODIFICATION OF SYSTEM SHOWN IN FIG. 1.

If the carbons should slip through the clutches when the lamps are burning the current will increase on the circuit, and the fuses may blow or the remaining lamps will draw long arcs of abnormal potential causing the shunt coils to burn out. This method of operation can hardly be considered practical when more than twelve lamps are operated in series on a constant-potential alternating-current circuit.

On account of the absence of a regulating device in series with the lamps it becomes necessary to employ very large solenoids and cores in this type of lamp, therefore the efficiency and power-factor are lowered to a considerable extent. A lamp of this type is very heavy, weighing from forty to fifty pounds complete. It is necessary to use a hand-operated starting coil with this system, as shown in Fig. 1. A modification of this system is shown in Fig. 2.

In this case a constant-potential transformer, with taps on its secondary coil giving various potentials, is connected to the circuit through the medium of a regulator head, which is operated by hand. A number of relays not shown in the sketch are introduced in the circuit causing the regulator head to operate by the power of a spring or weight, in case a short-circuit on the line should occur. In addition to the regulator head already mentioned there is used a special starting device which prevents the lamps from chattering when they are being started.

The delicacy and complications of this system, in addition to its poor regulating qualities and comparatively low efficiency (which will not exceed eighty-five per cent under normal conditions), will limit the use of this type of system to smaller circuits and plants where the efficiency and regulation are not regarded as important factors. The above systems do not compensate for change in line voltage, therefore the current on the secondary circuit will fluctuate if the line voltage rises or falls.

METHOD NO. 2—THE CONSTANT-CURRENT TRANSFORMER SYSTEM.

There are two classes of this type of apparatus in operation at the present time.

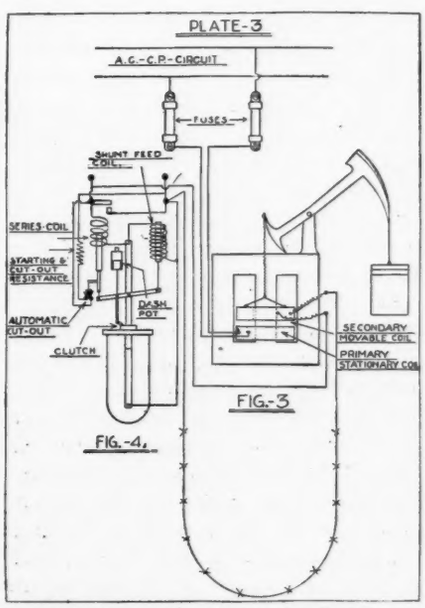


FIG. 3.—FLOATING COIL AUTOMATIC CONSTANT-CURRENT TRANSFORMER. FIG. 4.—LAMP AND DIAGRAM OF CONNECTIONS.

Class No. 1 is the floating coil automatic constant-current transformer which is illustrated in its simplest form in Fig. 3. This apparatus automatically

Paper read before the Ohio Electric Light Association, August 23, 1901.

changes the ratio of transformation by repulsion between the primary and secondary coils, always giving the required potential to the lamp circuit at a constant current. The current strength in the secondary and the pressure on the primary circuit govern the repulsion between the coils.

The illustration shows how the secondary coil, which is attached to a lever and a counterweight, can move up and down in the magnetic field, and the current strength required to repel the secondary coil may be adjusted, at will, within certain limits by changing the counterweight. This method of regulation compensates for increase or decrease in both number of lamps and line voltage.

On account of the inherent current regulation of this type of apparatus being limited at full load, it is necessary to use differentially wound arc lamps in connection with the same, as the regulation of this sytem depends to a large extent upon the impedance of the series-wound lamp coils introduced in series with the arc lamp circuits. This type of lamp is shown in Fig. 4. The fact is, a series of shunt lamps would not operate at all satisfactorily on a fully loaded constant-current transformer of the type illustrated without the introduction of a sufficient amount of ohmic resistance or impedance in series with the lamp circuit. The solenoids in a differentially wound arc lamp operating on the secondary of a constant-current transformer as described can be smaller than those used in lamps operating in multiple series across a constant-potential alternating-current circuit without a regulator, and the lamp does not require an arc-equalizing reactive coil. The efficiency of a lamp, suitable for operation on this transformer, with good regulation, will be about ninety per cent when warm. The efficiency of a 100-light (about sixty kilowatts) constant-current transformer of the type mentioned is stated to be ninety-six per cent maximum when operating with very low temperature rise.

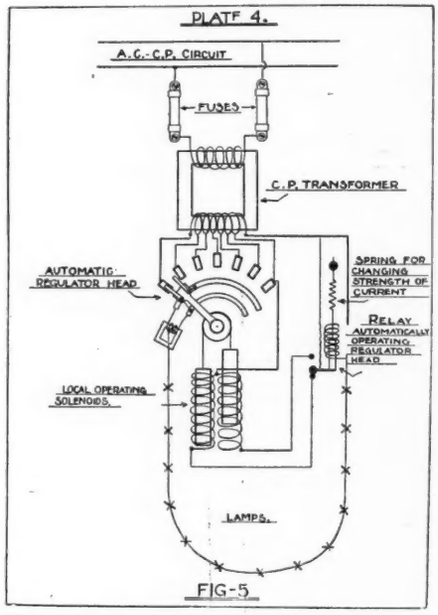


FIG. 5.—DIAGRAM OF AUTOMATIC CONSTANT-POTENTIAL TRANSFORMER FOR GIVING PROPER POTENTIAL TO LAMP CIRCUIT.

From the foregoing explanation and figures it will be seen that the maximum efficiency of a 100-light circuit of this type should be about eighty-six per cent. The power-factor of this system will vary within a wide range, depending on the primary voltage, number of lamps burning, length of arcs, style and quality of carbons and frequency. The writer has been informed that actual tests have been made on this system where a power-factor of seventy-five per cent at full load has been obtained under favorable conditions.

This system is not practical when the transformer carries less than three-quarter load, as the power-factor falls rapidly below that point. Therefore the benefit of this system is limited to circuits carrying practically full load at all times.

Class No. 2 comprises an automatic constant-potential transformer provided with means whereby change of current strength on secondary circuit automatically cuts in or out turns on the secondary coil of the transformer, thereby changing the ratio of transformation giving the proper potential to the lamp circuit at a constant current. Fig. 5 shows a diagrammatical sketch of this system. The differentially wound arc lamp having about ninety per cent efficiency, as shown in Fig. 4, must be used in connection with this type of transformer. The efficiency of a 100-light (sixty kilowatts) automatic transformer of this kind is very high, being about ninety-seven and five-tenths per cent.

This style of automatic transformer maintains practically constant power-factor and current on the system, under all conditions of load. The efficiency of a fifty to one-hundred-light circuit operating under normal conditions will be about eighty-seven and five-tenths per cent.

METHOD NO. 3—THE AUTOMATIC REACTIVE COIL SYSTEM.

We are now about to consider a series alternating-current enclosed arc lighting system, which has been in practical operation during the past two or three years.

Actual tests and demonstrations have proven this system to be exceedingly simple, efficient, safe and close regulating. The system is illustrated in its simplest form in Fig. 6.

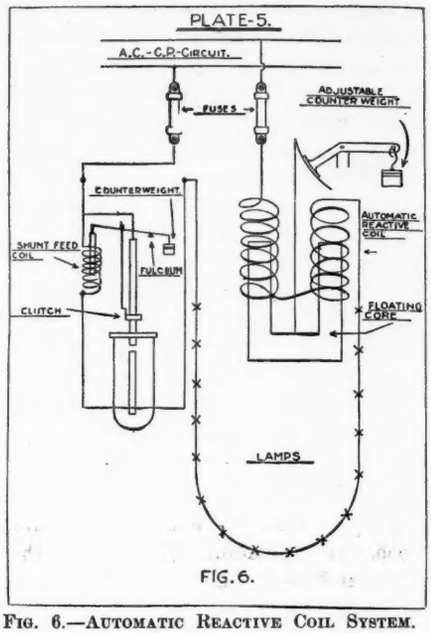


FIG. 6.—AUTOMATIC REACTIVE COIL SYSTEM.

You will remember that all of the systems to which the writer has already called your attention must necessarily have differentially wound arc lamps on their circuits. The illustration, Fig. 6,

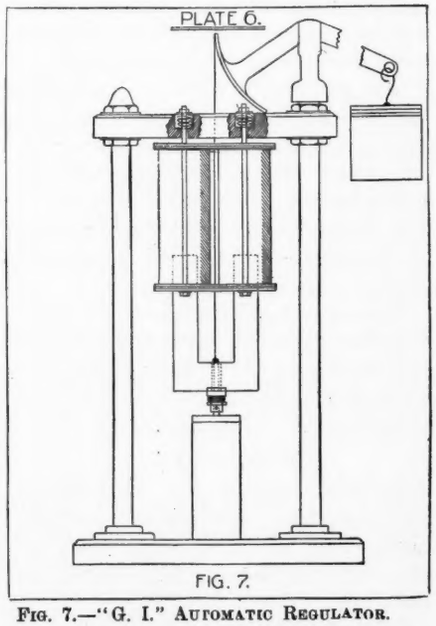


FIG. 7.—"G. I." AUTOMATIC REGULATOR.

shows the application of the shunt-wound arc lamp. The advantages of a series alternating-current lighting system, operating shunt-wound lamps, may be briefly summed up as follows:

Its efficiency is the highest.

Its power-factor is the highest obtainable, without the use of condensers.

Its regulation is perfect under normal conditions.

The regulating devices and arc lamps are very simple in design, therefore exceedingly reliable and easy to operate.

The number of watts on the lamp circuit can be changed at will, while the system is operating, by means of the regulator, without changing adjustment or voltage of the arc lamps.

The automatic reactive coil will keep the current constant on the lamp circuit under all conditions of load from short-circuit to full load.

The regulator will also compensate for a reasonable fluctuation in the primary voltage and frequency.

In a paper entitled "Series Enclosed Alternating Arc Lighting for Street Lighting," read by William Lispenard Robb, of Hartford, Ct., before the National Electric Light Association at its twenty-third annual convention, held at Chicago, Ill., in 1900, Mr. Robb quotes:

"It is to be hoped that a shunt lamp will be made that will do the work equally satisfactorily, although it seems extremely doubtful if a shunt lamp can be made to work on series circuits as satisfactorily as a differential lamp." "The use of the

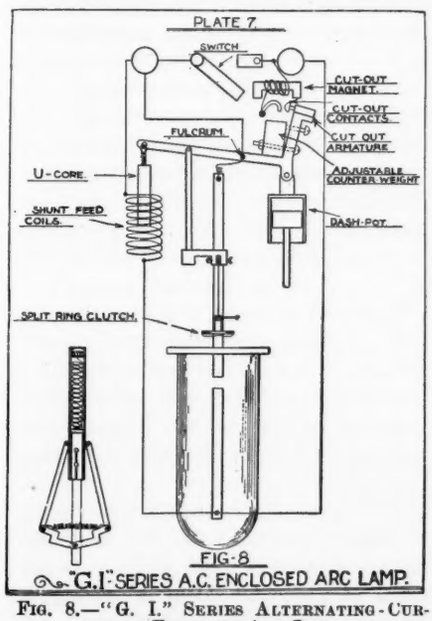


FIG. 8.—"G. I." SERIES ALTERNATING-CURRENT ENCLOSED ARC LAMP.

shunt lamp would mean a very material increase in the power-factor of the alternating series arc lighting systems."

The above statement is undoubtedly very much in favor of the shunt-wound arc lamp for series alternating circuits.

The automatic reactive coil system for series alternating-current lighting has received very little attention from the majority of central station managers up to within a short time, and it has been unjustly criticised by many ever since it was put on the market.

There appeared in the July, 1901, issue of the *American Electrician* a paper entitled "Arc Lighting at the Beginning of the Twentieth Century," which practically condemns the automatic reactive coil as used either directly on alternating-current constant-potential circuit, or in connection with constant-potential transformers.

In the same issue of the *American Electrician* appears a strong defence of the automatic reactive coil system, pointing out its many advantages, written by the editor.

Having demonstrated that the shunt-

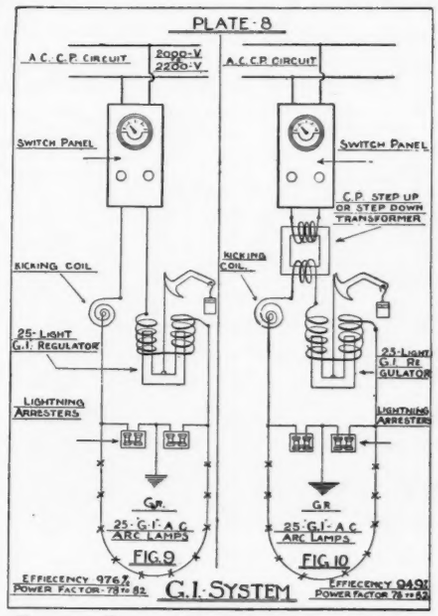
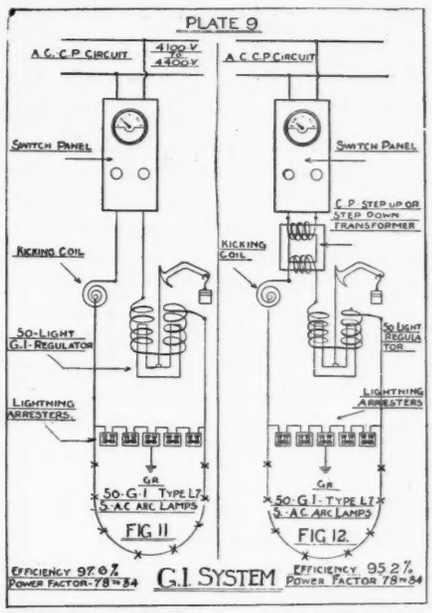


FIG. 9.—TWENTY-FIVE SERIES ARC LAMPS CONNECTED TO A CONSTANT-POTENTIAL ALTERNATING-CURRENT CIRCUIT. FIG. 10.—CONSTANT-POTENTIAL TRANSFORMER CONNECTIONS.

wound alternating-current series arc lamp, if properly designed, and automatic reactive coil are the most suitable for series alternating-current lighting, the writer will at once proceed to describe the construction and operation of the "G. I." regulating devices and arc lamps for series alternating-current circuits.

The "G. I." automatic regulator, or reactive coil, is illustrated in Fig. 7.

The regulator consists of two reactance coils mounted in a substantial metal frame, suspended on four spiral springs from a two-inch thick polished blue Vermont marble top. The marble top is supported on an iron frame which is secured to a two-inch thick polished blue Vermont marble base. A laminated iron core of either the "U" or "W" type is suspended under the reactive coils in such a way that it can play up and down in the magnetic field of the coils. At the lower



FIGS. 11 AND 12.—DIAGRAMS OF CONNECTIONS FOR FIFTY AND ONE-HUNDRED-LIGHT CIRCUITS.

end of the core is attached a metal strip which is fastened to the upper end of the arc on the lever which carries the adjustable counterweight. Below the core, and fastened to it, is a large air dash-pot which absolutely prevents "pumping" of the system and aids the starting of the lamps. Suitable binding-posts are mounted on the marble top, allowing the regular coils to be connected in series with the lamp circuit.

When the system is not operating only a small portion of the legs of the laminated iron core is surrounded by the windings of the reactive coils.

If the outside line is short-circuited, and current turned on, the core is immediately drawn into the coils which then react against the line potential, and keep the current constant at the value for which the regulator is adjusted to operate. When the short-circuit is removed the current on the circuit will fall, allowing the core to drop down. This will decrease the reactance of the regulator, and sufficient of the line potential is allowed on the lamp circuit to start and operate the lamps.

If one or more of the lamps should be switched off, or cut out, the resistance of the lamp circuit will decrease, and its current will increase. This causes the regulator coils to attract the core, which, when entering the coils, further increases the reactance of the regulator and the

current will again be brought to its given value.

From the above suggestions and explanations it will be seen that the current on the circuit is inclined to vary with the changes of load on the lamp circuit, but on account of the regulator coils being in series with the circuit of lamps and the core moving up and down with the slightest change of current, the automatically changing reactance of the regulator coils will always give the proper voltage and current to the lamps, no matter how many may be burning, as long as the voltage at the terminals of the constant-potential alternating-current circuit furnishes not less that eighty volts per lamp.

It will be observed, and should be remembered, that the "G. I." alternating-current regulator has no moving wires or coils, therefore all trouble due to broken leads and loose connections is obviated.

The efficiency of a fifty-light "G. I." regulator is 98.8 per cent.

Current regulation from no load to full load is within 0.2 ampere.

Floor space, twenty-four by seventeen inches.

Maximum height, forty-two inches.

Total weight, about 450 pounds.

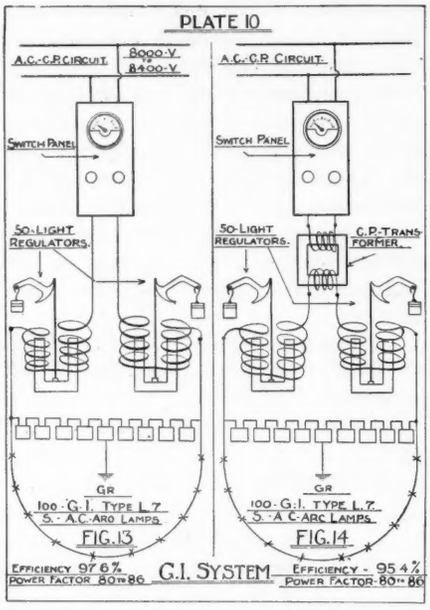
The "G. I." series alternating-current enclosed arc lamp is illustrated in Fig. 8. The lamp operates on the shunt principle, and is provided with an automatic cutout and a substantial hand switch. A feed lever is provided, which carries on one end a lead weight; on the other, a U-shaped laminated iron core is attached. Two shunt coils connected across the arc surround the legs of the U-core.

The clutch is of the split-ring type, and is supported from both sides, causing the carbon to be lifted centrally without undue friction. Particular attention is called to this feature of the clutch, as it is one of the utmost importance to eliminate all friction in the operating parts of the series alternating-current arc lamp. There are absolutely no windings in series with the arc.

The arc voltage is the same as at the hangers and the only loss in the lamp, when operating, is due to the power consumed by the shunt-wound feeding coils. These coils consume about from ten to twelve apparent watts or from five to six actual watts.

The efficiency of the lamp is 98.6 per cent; voltage of lamp, 70 to 72; voltage at which lamp feeds, 75; life of one 9½ by ½-inch cored carbon, 80 to 90 hours; power-factor of lamp, 88 to 91, and weight of lamp, complete, with outer globe, solid copper shell and reflector, 28 pounds.

The operation of the lamp is as follows:



FIGS. 13 AND 14.—ANOTHER DIAGRAM OF CONNECTIONS FOR FIFTY AND ONE-HUNDRED-LIGHT CIRCUITS.

When no current is passing through the lamp, the counterweight, acting through the clutch, separates the carbons. When a current is passed through the circuit carrying one or more of these lamps, its path is through the shunt magnets, which, as shown in the diagram, are connected around the arc. The shunt magnets attract their armature, which, acting through the clutch, allows the carbon to feed and be brought together, and thus shunt-circuits the shunt magnets, the counterweight being at this moment unresisted by the pull of the shunt magnets, then strikes the arc, and the arc is maintained practically constant by the varying action of the shunt magnets acting against the counterweight.

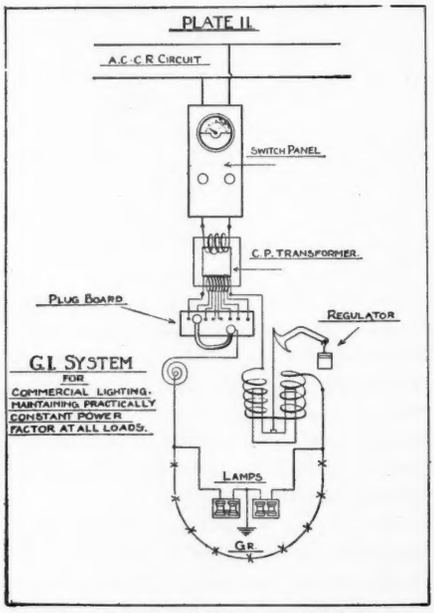


FIG. 15.—"G. I." SYSTEM FOR COMMERCIAL LIGHTING, MAINTAINING PRACTICALLY CONSTANT POWER-FACTOR AT ALL LOADS.

Should the upper carbon stick for any reason and not be fed downward when the clutch acts, the resistance of the arc will increase and more current sent through the shunt magnets, which attract their armature and lift the counterweight until the spring cutout contact above the counterweight is brought in contact with the stationary cutout contact mounted on the cutout coil.

This action, it will be seen by reference to the diagram, shunts the current around the lamp, through the cutout coil, extinguishes the arc and holds the lamp automatically cutout until the carbons are again brought together or the switch is operated.

The shunt lamp shown in Fig. 8 can also be used as a differential lamp, in which case the counterweight is omitted, and two series-wound solenoids, with their U-core, are connected in the circuit for drawing the arc. On account of the close regulating qualities of the automatic reactive coil, when constructed with open magnetic circuit, the series-wound solenoids and U-core can be very small, hence the efficiency of this lamp operating on the differential principle is about ninety-four per cent. The writer believes that the only advantage of a series alternating-current differential over a properly designed and constructed shunt lamp is that there is no flush of current at starting. Therefore, if incandescent lamps are operating on the same circuit, they will not be subjected to an abnormal rise in current when the arc lamps are started.

Having thus described the construction and operation of the "G. I." regulator, and series enclosed arc lamp, the writer will show on plates Nos. 8, 9, 10 and 11 a number of combinations of transformers, regulators, lightning arresters and arc lamps.

In Fig. 9 is shown twenty-five series arc lamps connected through the regulator and switch panel directly to the mains of a constant-potential alternating-current circuit.

This method of operating the series alternating-current arc system directly from the mains of the constant-potential generators may be considered good practice when the series circuits are thoroughly well insulated.

When the arc lamps are connected, as shown in Fig. 9, the cost of the system

is reduced to a considerable extent, on account of the constant-potential transformer not being necessary. It will also be observed that the efficiency is materially increased by omitting the use of constant-potential transformers.

Fig. 10 on the same plate illustrates how the constant-potential transformers are connected to the circuit. When the voltage of the constant-potential alternating-current circuit is too low or too high for the arc circuit it is of course necessary to use a step-up or step-down constant-potential transformer, which, in that case, also serves the purpose of insulating the alternating-current circuit from the multiple system.

Plates Nos. 9 and 10 illustrate the connections for fifty and one-hundred-light circuits. There is also given the efficiencies and power-factors of the various combinations.

When it is necessary to operate a series alternating-current circuit for commercial lighting, where the number of lamps are liable to change from quarter load up to full load during the different periods of the year, a system as shown on plate 11 is recommended.

The plugboard is connected with the loops of the constant-potential transformer and to the circuit in such a way that the voltage on the lamp circuit can be adjusted for the number of lamps connected, thereby maintaining a practically constant power-factor at all loads.

In addition to the methods of operating alternating-current lamps in series on constant-potential circuits already mentioned in this paper, experimenting is now being conducted on series alternating-current arc light systems operated in connection with reactive coils and condensers.

Before concluding this paper it may be of interest to consider the following tables, made for ready reference, which are intended to show how great a saving can be made in both cost of installation and operating expenses of series alternating-current enclosed arc lamps by using the reactance coil and shunt-wound arc lamps in place of the other systems described and illustrated on plates 1, 2 and 3, all of which have to use differentially wound lamps, introducing a loss of from seventeen to thirty watts per lamp in the series lamp coils.

Taking the average loss in the series coils of each differentially wound lamp at twenty watts and the cost of power at three and one-half cents per kilowatt-hour delivered at the arc lamps, we have the following saving by using the shunt-wound arc lamp, applied as shown on plates 5, 7, 9, 10 and 11.

TABLE SHOWING SAVINGS EFFECTED BY USING SHUNT-WOUND ARC LAMPS FOR SERIES ALTERNATING LIGHTING SYSTEMS IN PLACE OF DIFFERENTIALLY WOUND ARC LAMPS.

PLATE NO. 12.

Number of Lamps. 500 Watts Each.	Saving of Boiler Capacity.	Saving of Engine Capacity.	Saving of Generator Capacity.	Saving of Line Capacity.	Saving of Transformer Capacity.	Cost of Power Saved per Hour.
50	1.35 H. P.	1.35 H. P.	1 Kw.	1 Kw.	1 Kw.	$0.3½
100	2.7 "	2.7 "	2 "	2 "	2 "	.7
200	5.4 "	5.4 "	4 "	4 "	4 "	.14
300	8.1 "	8.1 "	6 "	6 "	6 "	.21
400	10.8 "	10.8 "	8 "	8 "	8 "	.28
500	13.5 "	13.5 "	10 "	10 "	10 "	.35
600	16.2 "	16.2 "	12 "	12 "	12 "	.42
700	18.9 "	18.9 "	14 "	14 "	14 "	.49
800	21.6 "	21.6 "	16 "	16 "	16 "	.56
900	24.3 "	24.3 "	18 "	18 "	18 "	.63
1,000	27 "	27 "	20 "	20 "	20 "	.70
2,000	54 "	54 "	40 "	40 "	40 "	1.40
3 000	81 "	81 "	60 "	60 "	60 "	2.10
4,000	108 "	108 "	80 "	80 "	80 "	2 80
5,000	135 "	135 "	100 "	100 "	100 "	3.50

It should be understood that the above table does not take in account any savings but those due to the use of shunt lamps.

There are other savings due to the use of the high-efficiency reactive coils and constant-potential transformers in place of special constant-current transformers of lower efficiency.

Local conditions will cause these additional figures to vary, therefore they have not been put in the general table. The savings due to the use of the reactive coils are particularly high, varying from two to three per cent, where it is practicable to operate directly across the constant-potential mains without the use of a constant-potential transformer between the mains and the arc circuits.

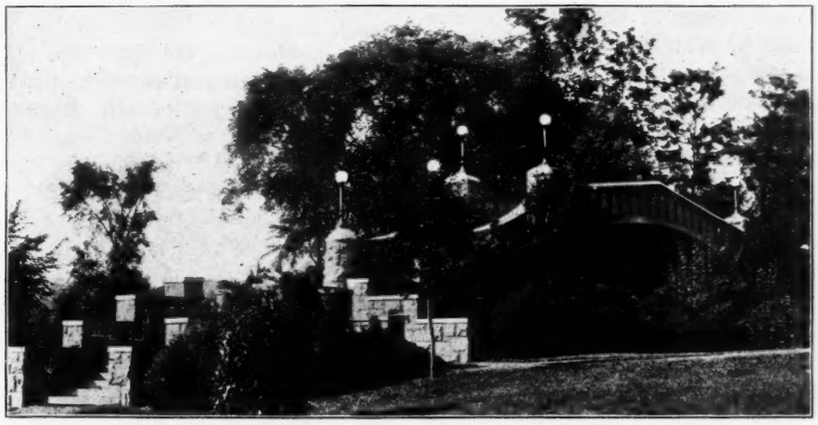
In this latter case the first cost is also materially decreased on account of the constant-potential transformers not being necessary.

Professor George J. Brush, who was formerly director of the Sheffield Scientific School of Yale University, was presented with a loving cup by some of the former graduates at the recent bicentennial exercises.

ELECTRIC ORNAMENTATION OF A PARK BRIDGE.

BY H. G. TYRRELL, C. E.

The accompanying photograph illustrates the electric lighting of a park bridge recently built at Madison, N. J. It serves the double purpose of a foot-bridge and a park ornament.



ELECTRIC LIGHTING ON A PARK BRIDGE.

The eight electric lamps, four at each end, mounted on the top of ornamental standards serve to add grace and prominence to the bridge, both by day and night. It spans two lines of railway where they cross the park in a deep cutting. The centre part of the bridge is a steel plate girder built in the form of an arch. It has a clear span of fifty feet and a width of ten feet. The two girders are connected at the bottom with light beams, and between these corrugated curved iron sheets are laid. The girders are held in a vertical position by gusset plates riveted to stiffeners on the web, and fastened to the floor beams.

Beneath the floor beams are cross-braces in the plane of the bottom chord, and at each end there is a vertical cross-frame. The girders are capped with heavy cast-iron hand-rails.

The abutments are built of ornamental stonework, and on top of the stone posts are set the electric lamps.

The whole structure is surrounded with plants and shrubs, and presents altogether a pleasing appearance.

Book Reviews

"Outlines of Electrochemistry." By Harry C. Jones, Associate Professor of Physical Chemistry in the Johns Hopkins University. Cloth. 7 by 10 inches. 113 pages. Numerous illustrations. The Electrical Review Publishing Company. New York. Furnished by the ELECTRICAL REVIEW at $1.50.

Professor Jones has produced, in this small volume, a work of high value. Electrochemistry has grown so rapidly that many engineers, familiar with the dynamical applications of electricity, have not found the opportunity to familiarize themselves with the newer development. As there is no other department of electrical engineering so rapidly growing as is the application of the electric current in chemical reactions, interest in the subject has increased greatly and a demand has been felt for a book that would introduce the intelligent reader to the subject in the easiest and most practical way. To meet this demand, Professor Jones prepared a series of papers which were published in the ELECTRICAL REVIEW under the title "Selected Chapters in Electrochemistry," and which, with an introduction and numerous additions and emendations, form the subject-matter of the present volume. Beginning with a chapter on osmotic pressure, the foundation work of the earlier investigators in electrochemistry is described, and in a second chapter the theory of electrolytic dissociation is set forth. Applications of this theory, electrolysis, the velocity of ions, conductivity of solutions and the calculation of the electro-motive force of elements are the remaining subjects. Dr. Jones unites with a logical and forceful presentation such unusual felicity of style as to make his book as interesting as it is valuable.

"Handbook for the Electrical Laboratory and Testing Room," Vol. I. By J. A. Fleming. 5½ by 9 inches. Cloth. 530 pages. 213 illustrations. London. The Electrician Publishing Company. Supplied by the ELECTRICAL REVIEW at $5.00.

Dr. Fleming, in producing this elaborate work, has undertaken to deal with the subject with a view to the requirements of electrical engineers rather than those of physicists. The present treatise is divided into chapters, each dealing with one particular class of measurements, and containing probably the fullest and most complete information on the subject of each that has yet appeared in any language. The present volume contains five chapters devoted, respectively, to the equipment of testing rooms, measurement of resistance, measurement of current, measurement of electro-motive force and measurement of electric power. In the second and forthcoming volume such subjects as capacity, inductance, electric quantity and energy, battery and meter testing, magnetic testing, photometric work and the design of dynamos, motors and transformers will be taken up. The work is a practical handbook, the brief mathematical discussions which are introduced having been put in small type and so arranged that they may be omitted by the reader who is not looking for the most complete information as to methods. The book is one that should find use in the testing rooms of factories and supply stations, and ought also to make an admirable textbook for advanced courses in electrical engineering.

"Electrical Engineers' Pocketbook." By Horatio A. Foster. 4 by 5½ inches. Flexible leather. 1,000 pages. Many illustrations. Published by D. Van Nostrand Company. Furnished by the ELECTRICAL REVIEW at $5.00.

Mr. Foster has succeeded in producing what many authors have striven for—a really practical and valuable engineering pocketbook. The data given are sufficiently full, and at the same time the book is not padded with the usual mass of entirely useless information which often distinguishes such publications. Beginning with a discussion of electrical engineering symbols and units, it describes the various instruments now in use for electrical measurements themselves, giving the practical methods now in use for the testing of all the varieties of electrical apparatus. The sections concerning power transmission, switchboards, transformers and the various engineering applications of the electric motor and the electric light, are very full and make interesting reading. The volume is one that can be recommended without reserve to those who desire a simple, practical and conveniently arranged compendium of information on electrical subjects.

"Theoretical Elements of Electrical Engineering." By Charles P. Steinmetz. 6 by 9¼ inches. Cloth. 327 pages. 143 illustrations. New York. *Electrical World and Engineer.* Furnished by the ELECTRICAL REVIEW at $2.50.

Mr. Steinmetz explains in his preface that this work originated, in part, from a series of university lectures which he once promised to deliver. It is to be regretted that his promise was not fulfilled and that the admirable method for the analytical study of electrical phenomena which he has developed in this book and in his classical work on the alternating current should not have been more widely taught. The new book may be regarded as an introduction to the author's larger work on "Alternating-Current Phenomena," and contains also a series of monographs on important apparatus of both direct and alternating-current types. It is one of the most valuable works that has recently appeared.

"Lessons in Practical Electricity." By C. Walton Swoope. 5 by 7½ inches. Cloth. 462 pages. 385 illustrations and two plates. New York. D. Van Nostrand Company. Supplied by the ELECTRICAL REVIEW at $2.00.

The author of this book has worked with particular pains to produce a text-book for practical mechanics and other people who desire to know something about electricity without entering into the mathematics of the subject to any great extent. His efforts have been excellently successful, and the book is one that should commend itself to teachers of elementary electricity, primarily on account of the common sense exhibited in it. It is an excellent, plain, simple, straightforward treatise, and handles its subject with no little felicity. It is believed that a considerable field for usefulness is open to it, and that it will probably take its place as one of the standard works of its class.

"The Electromagnet." By Townsend Wolcott, A. E. Kennelly and Richard Varley. Second edition. 4¼ by 6½ inches. 134 pages. Many illustrations. Cloth. Published by the Varley Duplex Magnet Company, Phillipsdale, R. I. Supplied by the ELECTRICAL REVIEW at $1.00.

This convenient little volume furnishes a great deal of valuable information about electromagnets—information of the kind that practical people want to have in a short compass. It is a sufficiently complete treatise to enable the design and construction of electromagnets for any given variety of work, and its authors have collaborated successfully to produce a really useful and valuable work.

"Les Applications Pratiques Des Ondes Electriques." By Albert Turpain. 5½ by 9 inches. 412 pages. 271 illustrations. Paris. C. Naud. Supplied by the ELECTRICAL REVIEW at $4.00.

Professor Turpain has given in this work a history of the utilization of electric waves, and a very elaborate and complete description of modern methods of wireless telegraphy and its various applications. The work will be found of great interest to students of these subjects and appears to be very complete and thorough.

"Practical Lessons in Metal Turning." By Percival Marshall. 5 by 7 inches. 166 pages. 193 illustrations. London. Sawbarn & Ward, Limited. Supplied by the ELECTRICAL REVIEW at $1.00.

This is a plain, practical book, and should be appreciated, especially by amateurs who do much lathe work. It is very complete and is illustrated with practical diagrams giving the kind of information that is desired by those who are experimenting with mechanics.

Small Alternating-Current Single-Phase Motors.

There has long been a strong demand for a really satisfactory single-phase motor, as there are numerous uses to which such a motor could be applied. One of the main disadvantages of alternating-current distribution has heretofore been the inability to produce thoroughly reliable and satisfactory motors of good starting torque and small starting current for single-phase alternating-current circuits. This feature, more than any other, has led to the use of polyphase alternating-current distribution. For lighting with incidental power in small motors, single-phase alternating current offers a great advantage by its superior simplicity, so that even when a polyphase system is used, for small powers, it is generally more convenient to use single-phase motors.

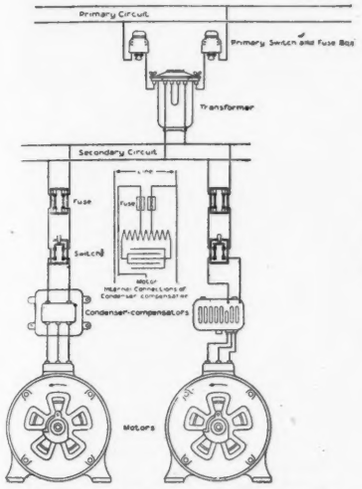


FIG. 1.—CONDENSER COMPENSATOR CONNECTED TO MOTOR.

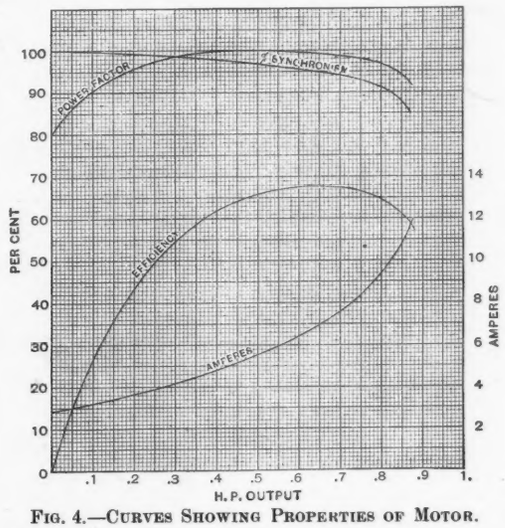


FIG. 4.—CURVES SHOWING PROPERTIES OF MOTOR.

Heretofore, however, single-phase motors have been very unsatisfactory, especially for 125 cycles, which is the frequency most commonly used for single-phase systems. Their absence of starting torque required complicated starting devices, either external appliances or a commutator. One of the main advantages, however, which the alternating-current offers over direct current is the elimination of the commutator, and its reintroduction, even for starting motors, is, therefore, not a desirable feature.

Single-phase alternating-current motors suffered from the disadvantage of very low power-factor, that is, required excessive lagging currents, so that on 125 cycles single phase an ordinary one-horse-power motor, as a rule, even when doing no work whatever, consumes more than one horse-power in current.

While this current represents only apparent energy, its effect on lights operated on the same system is disastrous, and even very small single-phase motors, when running, and still more when starting—due to the excessive starting current required—pull down the lights operated on the same circuit to such an extent as to seriously interfere with their satisfactory operation.

In striking comparison with this is the simplicity of the induction motor. No commutator, collector rings, brushes or connections of any sort to the armature are required. The armature is either a solid mass of iron, copper bars and copper end rings, or where starting resistance is employed to increase starting torque and diminish current at starting the resistance with its switch can be included within the body of the armature, controlled by a sliding collar and lever or by a simple push-rod projecting at the end of the shaft.

A polyphase induction motor, when run up to its speed, will continue to run on one phase if the other phases are disconnected; its power output is, of course, reduced and its magnetizing current increases considerably. Some means of making such a motor self-starting are needed when operating from single-phase circuits, and also to correct the lower power-factor due to the large magnetizing current.

The single-phase condenser motor, as built by the General Electric Company, of Schenectady, N. Y., has a complete three-phase winding, one phase of which is connected to the supply while another phase is shunted by a condenser. This arrangement produces an electrical and magnetic displacement of the phases corresponding to that which exists when the motor is operated on a three-phase circuit. By this means a self-starting motor is obtained which starts up under full load, and since the condenser is so proportioned as to supply the entire magnetizing current, the motor operates at a power-factor of 100 per cent. Such a single-phase condenser motor is said to possess all the good characteristics of the standard three-phase motor, and to be superior thereto in power-factor.

Since the output of a given condenser varies with the square of the voltage at which it is operated, it is found most economical in connection with motors wound

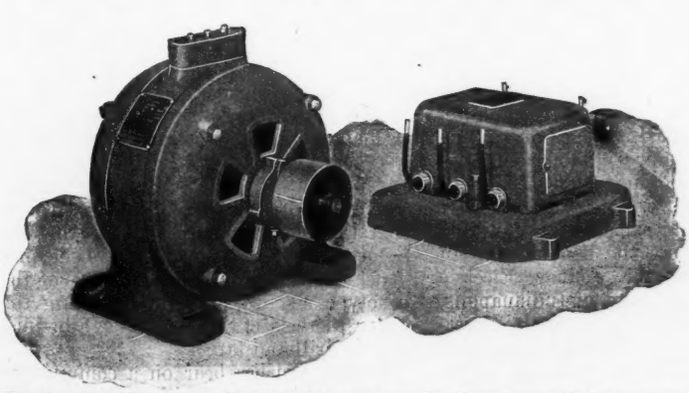


FIG. 2.—ONE-HALF HORSE-POWER MOTOR WITH ITS CONDENSER COMPENSATOR.

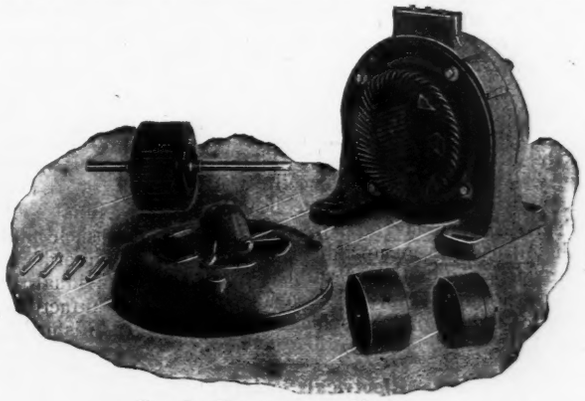


FIG. 3.—PARTS OF THE MOTOR.

The self-starting single-phase synchronous motor requires a wound armature provided with both commutator and collector rings with their attendant brushes, as well as a complex switching device to change the connections when the motor has attained speed.

for low voltages to employ a small transformer or compensator which steps up the v ltage applied to the condenser, the latter being actually operated at 500 volts. Condenser and compensator are combined in one unit, known as the condenser-compensator.

The condenser-compensator is permanently connected to the motor, as shown in Fig. 1. The motor is started in the same way and with the same ease as any polyphase induction motor.

The one-half-horse-power, 125-cycle motor, with its condenser-compensator, is depicted in Fig. 2. Fig. 2 shows the various parts of the motor. The power-factor,

FIG. 1.—LINOTYPE MOTOR.

efficiency, current and speed curves of this motor are given in Fig. 4.

The one-quarter and one-half-horsepower, single-phase motors are provided with centrifugal clutch pulleys which enable the armatures to reach speed before the load is applied. This clutch consists of a split ring, which is expanded by means of a centrifugal weight so as to engage the inner surface of the pulley when the proper speed has been reached. The larger single-phase motors are provided with a starting switch and electrical connections which limit the current at starting and at the same time allow the motor to develop strong starting torque, in the same way as is customary with polyphase motors.

The bearings are lubricated automatically and the reservoir requires only occasional examination to see that the oil is kept at the proper level. The motors may be adapted to wall or ceiling suspension by simply turning the bearings 90 degrees or 180 degrees, in order to keep the oil parts in an upright position. The bearings may be turned without removing the armature. Slots are provided in the feet of the motor to provide for adjusting the belt.

New York Electrical Society.

The 218th meeting of the society will be held at the College of the City of New York, corner Lexington avenue and Twenty-third street, Tuesday, November 26, at 8 P. M. Mr. Robert Lozier will present a paper on "The Electrical Operation of Modern Tools and Machinery."

Linotype Motors.

The introduction of electricity into the printing office has opened up an inviting and profitable field for electric motors and appliances, and has resulted in a complete transformation of the working conditions in the mechanical department of the modern printing establishment. The absence of shafting and belting, with their attendant noise and dirt, the economy of floor space with a proportionately greater output of a better grade of work, the more complete and absolute control of speeds, and economy in power consumed in operation are some of the most noticeable results of these changed conditions.

The Linotype machine is one of the most important elements in the equipment of a newspaper or printing establishment, and, consequently, an economical and satisfactory drive for this machine is one of the live problems confronting the mechanical man of such a plant.

It has been the general practice to drive Linotypes from countershafts, but this is open to all the objections of belting and shafting. One of the wasteful features in driving from a line-shaft is that the shaft, with its driving motor, as well as the belts on loose pulleys, are in operation when only one or two Linotypes are in service. When the machines are driven with individual motors they may be located in the most convenient place for light, or to economize space, and can be moved without affecting the driving process. In order to reduce the disadvantages of driving by belts to a minimum it has been the practice in many composing rooms to locate the Linotypes on an elevated floor, so as to provide room for driving-shaft under the floor. The use of individual motors overcomes the necessity for such additional expense.

In order to meet the demand for an individual motor, the Jenney Electric Manufacturing Company, of Indianapolis, Ind., is making a 110 and 220-volt, direct-current motor, to be mounted upon and geared to the Linotype machine. The motor virtually becomes a part of the machine, making the combination a unit to itself, dependent upon nothing except the supply of current. The breaking or slippage of belts, hot boxes or other minor accidents which are liable to shut down the entire Linotype plant are entirely avoided. Not only are the machines self-contained, but the regulation or speed is perfect, an important feature, as any irregularities in the speed of the Linotype is very annoying to the operator. In order to allow for a fine adjustment of speed there is an auxiliary field winding with five connections to a terminal board on top of the motor. By this means a variation of ten revolutions per minute in the speed of the Linotype machine is realized, so that the operator can make adjustment to suit conditions.

The motor as a whole is very compact and neat in appearance and its efficiency is all that could be desired. The energy taken by the motor to run the Linotype is from 90 to 100 watts, or less than that required by two sixteen-candle-power incandescent lamps.

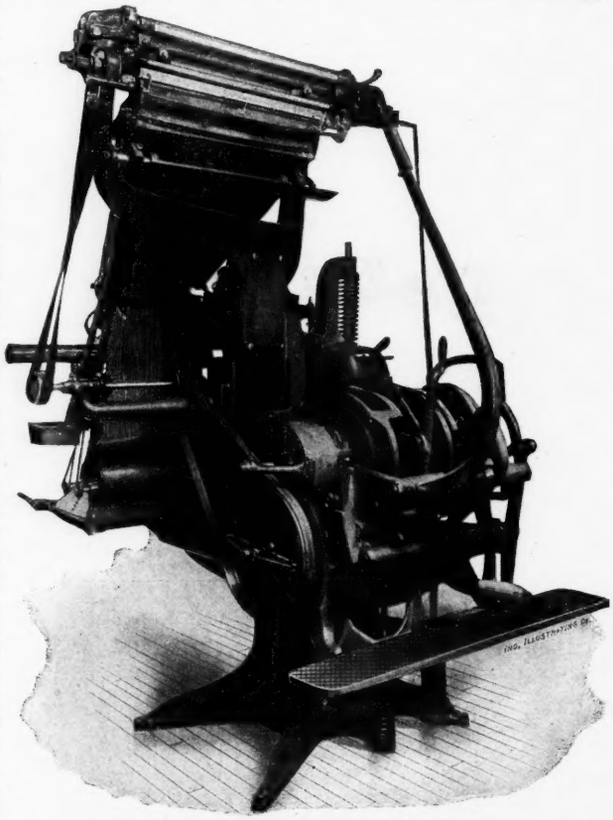


FIG. 2.—LINOTYPE WITH MOTOR IN PLACE.

The motor is multipolar and entirely enclosed, the field frame being cylindrical, with an ornamental, ventilated front head. The bearings are of phosphor-bronze and self-oiling. Two projecting lugs on the frame are drilled to receive bolts which hold the motor rigidly in place on the Linotype frame. These bolts are the ones that hold the cap on main bearings of the Linotype machine, and in mounting the motor there is but one three-eighths-inch hole to drill and tap.

Carbon brushes bear on a commutator with radial bars flush with the front head. The armature consists of machine-formed coils placed on a toothed laminated core. The bronze pinion on the motor-shaft and gear on the Linotype have cut teeth. Every part of these motors is interchangeable and of the best material and workmanship, which accounts in part for the excellent service rendered.

Motor-Driven Machine Tools.

The accompanying illustrations represent some recent applications of Bullock motors to machine tools, which are interesting as showing the adaptation of electric driving for various classes of machine work. In Fig. 1 is shown a grindstone, the machine being made by the Brown & Sharpe Manufacturing Company, and the appliance now being in operation at the League Island Navy Yard, near Philadelphia. Figs. 2 and 3 show lathes of large size in the works of the Fore River Engine Company at Quincy, Mass. These lathes were made by the Fitchburg Machine Company, and one of them is 110 feet long over all. Bullock motors are mounted on the head and tail-stocks of these lathes, the speed control being obtained by the Bullock multiple-voltage system, giving six speeds in either direction without the use of resistance in the field or armature circuits. The Fore River Engine Company has upward of 120 motors of the Bullock Electric Manufacturing Company's make now in operation in its works.

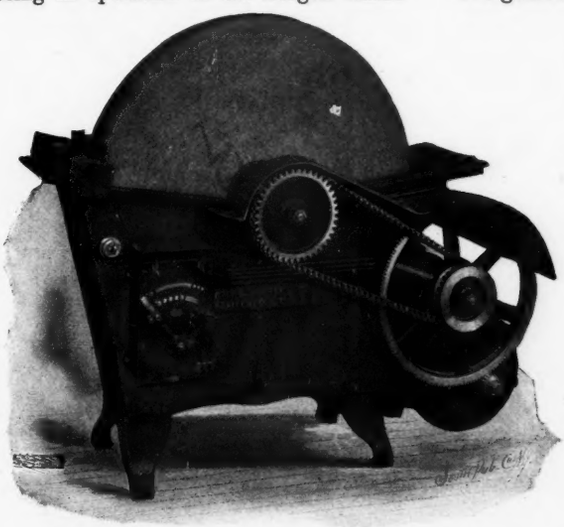


FIG. 1.—MOTOR-DRIVEN GRINDSTONE.

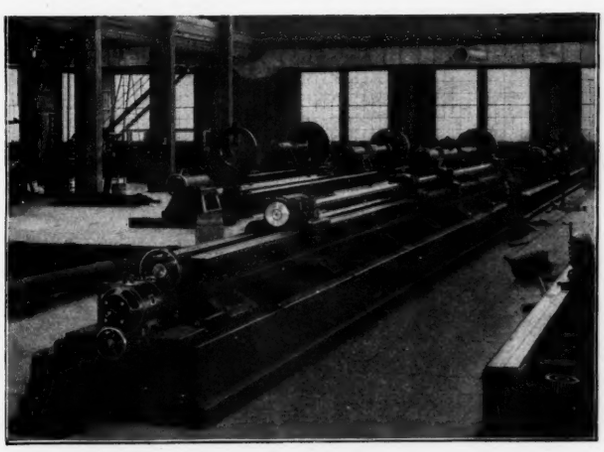


FIG. 2.—MOTOR-DRIVEN LATHE.

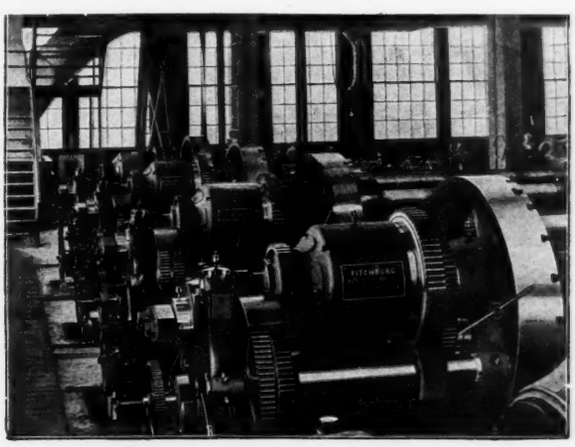


FIG. 3.—HEAD STOCK OF MOTOR-DRIVEN LATHE.

American Institute of Electrical Engineers.

The 158th meeting of the Institute will be held at the house of the American Society of Mechanical Engineers, 12 West Thirty-first street, New York, and at the rooms of the Western Society of Engineers, Monadnock Building, Chicago, Friday evening, November 22, at 8.15 o'clock.

The general subject of the meeting will be "Distribution Systems," with an introduction by President Steinmetz. The following papers will be presented: "Distribution of Electrical Energy in Large Cities," by Mr. Louis A. Ferguson, of Chicago. The paper is based on the author's experience in Chicago, and his observations in Berlin and Milan. "Locating Faults in Underground Distribution Systems," by Mr. Henry G. Stott, of New York. "Alternating Current as a Factor in General Distribution of Light and Power," by Mr. Charles F. Scott, of Pittsburgh. "The Buffalo High-Tension Cable Distribution System," by Mr. Harold W. Buck, of Niagara Falls. "Notes on the Alternating-Current System of Distribution," by W. S. Barstow, of New York. "The Distribution by the Three-Phase System, and the Operation of Single-Phase Circuits by It," by W. L. R. Emmet, of Schenectady.

It is expected that other papers also specially prepared for this meeting will be presented. As the above papers will be presented in abstract only, members who are especially interested in the subject are requested to send for and read the advance copies, which will also be distributed at the meeting.

Meeting of the Stockholders of the Manhattan Railway Company.

The annual meeting of the stockholders of the Manhattan Railway Company was held November 13, 1901. No change was made in the board of directors except that Mr. E. N. Foss, of Boston, who represents a large interest in that city, was elected to fill a vacancy. The officers of the company at present are: President, Mr. George J. Gould; vice-president, Mr. Alfred Skitt; secretary and treasurer, Mr. D. W. McWilliams. The report of President Gould was very gratifying to the stockholders. The company's facilities have been improved and enlarged during the past year, the line from Tremont to Fordham having been completed and in operation since July 1.

Great progress has been made in the change to electrical equipment during the year. Most of the buildings for the power stations have been completed and the machinery is now being installed in all of them. The delivery of 300 new cars will be begun shortly and the engineers expect that the first machinery will be run by December 1, and that trains on the Second avenue line will be run by electricity some time during the month of December, to be followed as rapidly as possible by those on the other lines of railway.

McKinley Memorial.

Colonel Allan C. Bakewell, of the Sprague Electric Company, has been requested by the New York State Organization to receive subscriptions for the McKinley National Memorial Association. Colonel Bakewell should be addressed at 479 Fifth avenue, New York city, and checks should be made payable to the order of James G. Cannon, treasurer. It is to be hoped that the electrical interests will be well represented in contributions to this highly meritorious work.

Chicago Electrical Notes.

News of the Industry in the Western Field.

(By Our Special Correspondent.)

AGITATION of the question of a better street railway system for South Side Chicagoans may lead to an understanding between the aldermen and the Chicago City Railway Company, which now operates the traction lines in that section of the city. A conference on November 6, which was held behind closed doors, is said to have revealed the fact that the railway people have their troubles with the present cable system, as well as does the public. The former declare that they are anxious to do away with the cable and give the South Side people the best street railway system in the world, if the city will recognize their demand for a new franchise. The railroad people say that with the heavy loads and increased number of cars which they are now forced to haul, a cable, instead of lasting 120 days as it formerly did, only lasts from fifty to seventy days. A limit on these lines has been reached for the cable, and the company claims that it will inaugurate an excellent system, part of which shall be the underground trolley, if the franchise extension is granted. Next week the company will begin to place in service 120 new cars which it has lately purchased.

A rather interesting bit of traction gossip in the western field connects the name of Tom Johnson, mayor of Cleveland, Ohio, with an effort to secure control of the Chicago street railway properties. Indeed, it is affirmed by certain knowing ones that Mr. Johnson is prepared to make a traction offer which will give three-cent fares, transfers on all lines and numerous improvements. It is said that the Ohio man is simply waiting to see what the Council Committee on Transportation proposes to do for Chicago, and that he proposes to "go it one better" on its proposition.

"Her voice was ever gentle, soft and low;
An excellent thing in woman."—*King Lear.*

How often have you taken the receiver of a telephone and placing it to your ear had your tympanum jarred by a voice that was startling in its likeness to a cat fight? Well, no one will hear anything like that in Chicago again. The Chicago Telephone Company has established a school of what is known as "telephonic elocution," to the end that when the busy man flees to the telephone booth and shuts himself in from the harsh discords of the world, he may not have his nerves assailed by accents like mother-in-law "used to make," but may be soothed by the mellifluous "hello" of a well-schooled young woman in the central office. Therefore, from this time forth all applicants for position must have their voices passed upon by an examining board, and, if accepted, they are given a course in vocal training to thoroughly fit them for their work. In addition to these vocal attainments the company requires the young women who apply for positions to possess a good education and good health. General Manager Hibbard is to be commended in his efforts to better the service. Other cities might do well to follow his lead.

Charles H. Beers, one of the stockholders of the Central Union Telephone Company, filed a petition in the Circuit Court, in Chicago, on November 14, asking the court to appoint a receiver, in order that the rights of the minority stockholders may be protected from alleged manipulations of the stock of said company by the American Telephone and Telegraph Company. It is affirmed that the American company is making an effort to secure a controlling interest in the Central company and operate same without regard for the minority stockholders. It is shown that the purpose of the Central Union company was to erect and operate telephone lines in Illinois, Ohio, Iowa and Indiana, and that on August 1, 1901, the stock amounted to 69,630 shares, the value of which was $100 per share, of which the American company owned a controlling interest. It is alleged that if the business were capably managed the company would be able to pay large dividends and the stock would command its face value in the markets, but that because of the collusion and illegal actions of the two companies no dividends have been paid and the stock of the Central Union company has little market value.

The committee on local transportation of the Chicago city council has decided that passengers who stand in the cars must pay the same fare as those who have seats. An effort was made to have a reduced rate provided for those who could not secure seats, but the committee, after considering the proposition, decided that this feature would not be incorporated in the new franchise extension ordinance which is being formed.

Chicago, November 13.

Electric Train Lighting.

Of the many applications of electric light few are more interesting than that to the lighting of railway cars. At first sight it may appear that the lighting of a railway car is a simple matter and not essentially different from the lighting of any other space of the same dimensions, but this is particularly untrue for the reason that the car is liable to be at any time far removed from a convenient source of power, and that whatever system of electric lighting is adopted in connection with it must possess storage features, and to be successful must be self-contained within the limits of the car itself. In the early experiments, conducted both in this country and abroad on electric train lighting, steam-driven units were employed to light the train as a whole by means of conductors extending along its length. This system, while fairly satisfactory for the lighting of trains running as units, of course was not available as soon these trains were broken up into their constituent cars. Storage alone has not served to solve the difficult problems, since cars may be sidetracked or delayed beyond the time limit of the battery charge. The only solution that has been entirely practical is the utilization of some of the energy used to propel the car to run a dynamo geared to one of the axles and to utilize the current thus generated for keeping replenished the storage batteries carried on the car.

This system of late has been introduced very largely by a number of railroads, particularly by those operating in the middle-west states and for certain classes of service on several others. Notably in dining-car service the new light has been exceedingly satisfactory, the cars being brilliantly lighted, with an absence of heat and vitiation of air noticed with the gas-lighting system formerly in vogue. The experiment has been so successful on those railroads where it has been undertaken that the system will be largely extended. Among the recent lines equipped by the Consolidated Railway, Electric Lighting and Equipment Company, the company installing the "axle light," are the Louisville & Nashville and the Atchison, Topeka & Santa Fe, on which 110 cars have been equipped, and the dining-car service of the Pennsylvania company. A number of other leading roads have installed this service in their dining and buffet cars.

It is believed that the electric system is destined in the near future to supplant entirely other methods of illuminating first-class cars of all sorts and that its advantages will shortly be sufficiently appreciated to have its use extended to the ordinary passenger, local and suburban trains of the better-class railways. The same power has been successfully applied to operating ventilating fans, which have been of great comfort to passengers in warm and close weather. A fine exhibition of the system was made at the Pan-American Exposition and was awarded a gold medal.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

SAN FRANCISCO RAILWAY CHANGES HANDS—The Market Street Railway Company is said to have been sold to a Baltimore syndicate. It is expected that several millions of dollars will be spent in improving the property.

A NEW ELEVATED RAILWAY STATION—The Manhattan Elevated Railway Company, of New York, is erecting a fine station at 110th street on the west side. It is said that this station will be a distributing point for electrical power.

LARGE ST. LOUIS POWER PLANT—The north end power plant of the St. Louis Transit Company, which is to cost about $1,200,000, will be finished about February 1, 1902. The main building is two stories high and occupies 28,610 square feet of space.

INCREASE OF STOCK—The stockholders of the Commercial Pacific Cable Company have consented to an increase of the capital stock from $100,000 to $3,000,000, and a certificate for that amount of increase has been filed with the Secretary of State, at Albany, N. Y.

LONDON TRACTION AFFAIRS—It is reported that the Metropolitan District Electric Traction Company, in which Mr. Charles T. Yerkes is interested, has gained an interest in two projected tube railways which are intended to connect with the District railway.

WIRELESS TELEGRAPHY—The Lighthouse Board, at Washington, has requested an appropriation of more than $100,000 to be invested in wireless telegraph instruments. The plan is to have all the lighthouses along the coast in the near future in connection with the inland stations.

WASHINGTON TRACTION COMPANY—Mr. R. B. Tunstall, special master and commissioner, has been ordered to sell in foreclosure proceedings the securities of the Washington Traction Company prior to its reorganization. Nearly all the street railways in Washington, D. C., are owned by this company.

GERMAN HIGH-SPEED TRACTION EXPERIMENTS—Late reports from Germany indicate that the trials of the high-speed electric railway from Berlin to Zossen are successful and that speeds as high as 100 miles per hour with ninety-six-ton electric cars have already been attained. It is expected to reach speeds of 140 miles per hour.

OKLAHOMA ELECTRIC RAILWAY—Secretary Grimes has granted a territorial charter to the Oklahoma & Indian Territory Electric Railway Company, whose principal place of business is at Norman, Okla. The capital stock of this company is $1,500,000. A line is to be built from South McAlester, I. T., to Lawton, Okla., a distance of about 175 miles.

LARGE CALIFORNIA RAILWAY—A company known as the Pacific Electric Railway Company, with a capital of $10,000,000, has filed articles of incorporation in Los Angeles, Cal. It is said that the principal stockholder is Mr. H. E. Huntington, a nephew of the late Collis P. Huntington. The company's intention is said to be to build and operate a number of interurban electric railways in southern California.

BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY—It is said that the capital stock of the British Westinghouse Electric and Manufacturing Company will be increased by an issue of £250,000 of preferred stock to provide additional funds to be used in the completion of the company's new buildings and the purchase of machinery. The stockholders of the company are given the opportunity to take up the new stock.

SPANISH TELEGRAPH CONCESSIONS—The claim of the Western Union Telegraph Company that under the concessions from Spain it possesses the exclusive right to transmit private messages between the United States and Cuba has been denied by Secretary Root. Secretary Root has also decided that the rights of the Cuba Submarine Telegraph Company, which were granted by Spain, must be upheld. He has ordered Governor-General Wood to maintain the status in respect to private telegrams which was observed before the war.

ELECTRIC LIGHT ON ELEVATED RAILWAYS—Mr. W. E. Baker, who is the electrical engineer in charge of the electrical equipment of the Manhattan Elevated Railroad, in New York, states that the stations and station platforms of the Second avenue branch will be illuminated by electricity very shortly. Fifty lights of twelve candle-power will be used at each station. The same line will soon be fully equipped with electric power, the laying of the third rail having been completed. All that is needed now is the cars and the supply of current to equip it.

EASTERN MASSACHUSETTS ELECTRIC LINES CONSOLIDATED—A news despatch from Boston states that the consolidation of the Newton, Newton & Boston, Wellesley & Boston, Commonwealth & Lexington, and Boston Street Railway companies have been affected under the title of the Boston Suburban Electric Railway Company, with a capital of $6,000,000, equally divided between common and preferred stock. The consolidated roads have a total of sixty-six miles of track. The consolidation is a voluntary association similar to that of the Massachusetts Electric Companies. The securities of this association will be listed upon the Boston Stock Exchange.

MERGING OF INDEPENDENT TELEPHONE COMPANIES—A new company, known as the Interstate Independent Telephone and Telegraph Company, has been incorporated in New Jersey. Its authorized capital is $3,000,000 with a bond limit of $9,000,000. The first operations of the company, it is said, will take place in the states of Iowa, Illinois, Wisconsin, Michigan and Indiana. The incorporators are men who are interested in the Independent Telephone Company of Illinois. It is stated that the purpose of this company is to unite the Independent telephone companies of the country, beginning in Illinois and extending gradually over the country.

TRACTION CONSOLIDATION IN PITTSBURGH—It has just been announced that the Philadelphia Company, of Pittsburgh, Pa., has increased its bonded indebtedness to $22,000,000, and its capital stock to $36,000,000, for the purpose of absorbing all of the traction lines in the Pittsburgh neighborhood. This company already has control of the gas and lighting business of Pittsburgh and its vicinity, and will now have virtually control of all of the public service utilities of the neighborhood. Of the new issue $12,000,000 will be available in exchange for preferred stock of the Consolidated Traction Company of Pittsburgh, while $3,500,000 bonds will be available to provide funds for the immediate betterment and extension of the traction properties taken over. All of the Mellon traction and light properties has already been acquired. The amount involved in the new deal is $58,000,000.

ELECTRIC LIGHTING

SHAMOKIN, PA.—Good progress is being made upon the new Shamokin and Coal Township electric light plant.

EAST PEORIA, ILL.—An electric lighting system will soon be established, the contract for which is now being prepared.

SHANOPEE, MINN.—The electric light plant, which has been under construction for some time, is nearly completed.

LEBANON, MO.—Mr. James Garneau, of St. Louis, has bought the entire stock of the Lebanon Light and Magnetic Water Company.

WEST PALM BEACH, FLA.—Mr. Potter, president of the council, is interested in the construction of a municipal electric lighting plant.

HUTCHINSON, KAN.—The capital stock of the Hutchinson Light, Power and Heat Company has been increased from $200,000 to $600,000.

BOWMANSDALE, PA.—It is reported that the Lantz mill, which recently changed hands, will be converted into an electric light and power plant.

BARRON, WIS.—The city of Barron has purchased from the Barron Manufacturing Company its water power for electric lighting and waterworks purposes.

LOS ANGELES, CAL.—Mr. G. B. Ellis, in behalf of the Edison Electric Light Company, has applied for the privilege of taking water for power purposes from several different rivers.

PORTSMOUTH, N. H.—The Portsmouth Gas, Electric Light and Power Company has conveyed all its real estate, franchises and privileges to the Rockingham County Light and Power Company.

JONESTOWN, PA.—A contract for a complete electric power and light outfit for the plant of the Miller Shoe Manufacturing Company, of Jonestown, Pa., has been made with the Lebanon Electric Company.

GRAND RAPIDS, MICH.—It is said that the power plant, which is being built by the Thornapple Electric Company on the Thornapple River at Labarge, is expected to be in operation by the middle of December.

CAPE MAY, N. J.—A number of Philadelphia capitalists have purchased the Franklin Electric Light Plant from the W. O. Robb estate. This plant furnishes public and private electric lighting in the city.

ALAMEDA, CAL.—Plans and specifications have been adopted by the city trustees for an addition to the electric light plant to cost about $5,000. The clerk has been ordered to advertise for bids for an engine and dynamo.

CANAJOHARIE, N. Y.—A farm has been purchased by the Empire State Power Company which adjoins its property at the Schoharie Falls. Plans and specifications have been prepared for contemplated improvements. The contracts will be awarded within a short time.

KNOXVILLE, TENN.—It is reported that active work will soon be begun upon the construction of the plant of the Knoxville Power Company. A dam thirty feet high will be built, and a flume 4,000 feet long, which will give a fall of more than fifty feet at the site of the power plant.

TELEPHONE AND TELEGRAPH

JAMESTOWN, N. Y.—A plant is being installed by the Home Telephone Company.

PORTLAND, ME.—The telephone lines are being extended to Milton, Rumford and other places.

MIDDLEPORT, N. Y.—The Bell Telephone Company has completed the reconstruction of its plant.

ONAWA, IOWA—The Monona Telephone Company is preparing to extend its lines from Whiting to Sloan.

DECATUR, ALA.—The American Telephone Company has begun work on a line from Decatur to Memphis, Tenn.

WEST POINT, NEB.—A line from West Point to Bancroft is being constructed by the Nebraska Telephone Company.

SHERIDEN, WYO.—From this place telephone connections have been made with Sundance, Wyo., and towns in the Black Hills.

DANVILLE, ILL.—The branch of the United Telephone and Telegraph line which connects Danville and Muncie is nearly completed.

GALESBURG, ILL.—Mr. D. M. McIntire has begun the work of building a toll line of the Galesburg Union Telephone Company, from Galesburg to Knoxville.

NASHVILLE, TENN.—The city council has received an application for a franchise for an independent telephone system. It is proposed to use underground conduits.

NORTH BRANCH, MINN.—An amendment to its articles of incorporation, which increases its capitalization to $50,000, has been filed by the Minnesota Telephone Company.

NEWARK, N. Y.—The right of way for a new line at East Palmyra has been secured by the Bell Telephone Company. The company is now engaged in setting the poles and stringing the wires.

HERINGTON, KAN.—An additional telegraph wire is being strung from Herington to Chickasha along the Rock Island Railway. This was rendered necessary by the increased amount of business.

HANCOCK, TENN.—The offices of the Postal Telegraph Cable Company are to be changed. The company has leased an office from the Nashville, Hancock & St. Louis Railway, and will soon move to its new quarters, which are situated on West Ninth street.

READING, PA.—Mr. Thomas K. Leidy has placed a mortgage of the Consolidated Telephone Company of Pennsylvania on record for $6,000,000. The mortgage was given to the Equitable Trust Company of Philadelphia to secure five per cent gold bonds for that amount. Mr. Robert E. Wright is the president of the company.

JACKSON, MICH.—The People's Telephone Company is making great efforts to ensure the citizens an excellent service. The company has placed telephones on exhibition which were made by the Kellogg Switchboard and Supply Company, of Chicago, and which were said by experts to be excellent apparatus. A 3,000-line major multiple switchboard is being constructed for this company by the Kellogg Switchboard and Supply Company. It will have an equipment of 1,640 lines, a toll board with an equipment of thirty lines, a chief operator's desk, 1,400 wall telephone sets and 100 desk sets complete, besides the switchboard. The woodwork of this switchboard is to be of mahogany. The framework is of heavy angle iron construction which makes a very rigid structure and ensures an alignment for the apparatus contained therein for a long time.

OBITUARY NOTICES

HERR JOSEF VIRÁG, the well-known Hungarian engineer, died late in October at his home in Budapest. He was only thirty-one years old at the time of his death, but he had already made his mark in the scientific world. He had among other things made large improvements in rapid telegraphy apparatus with Herr Pollak.

MR. CHARLES H. L. KNIGHT died on October 11 after an illness of four months. Since January, 1897, Mr. Knight had been in the employ of Tiffany & Company as chief engineer and had charge of the steam and electric plant. Previous to his engagement with Tiffany & Company he had charge of the electric lighting plant of the New York *Herald*.

MR. THOMAS J. KENNEDY, whose home was in Jersey City, N. J., died recently at Delagoa Bay, South Africa, according to late despatches. Mr. Kennedy was in the employ of the General Electric Company as a mechanical engineer. He sailed September 18 to superintend the erection of machinery in the mines at Mysore, Southern India, in the fulfillment of a contract of the General Electric Company with the British Government.

LEGAL NOTES

EXECUTION BY ELECTRICITY—It is held in Storti *vs.* Com. (Mass.) 52 L. R. A. that the execution of a criminal by electricity is not a cruel or unusual punishment within the meaning of a constitutional prohibition of such punishment.

RAILWAY COMPANY NOT LIABLE FOR NEWSBOYS JUMPING ON AND OFF ITS CARS—A newsboy jumping on and off moving street cars to sell papers, without requesting the car to stop to receive or discharge him, and without receiving permission or asking leave or license, is held, in Padgitt *vs.* Moll (Mo.) 52 L. R. A. 854, not to be a passenger toward whom the carrier is required to exercise a high degree of care.

CONSENT OF A MUNICIPAL CORPORATION NECESSARY FOR A TELEGRAPH COMPANY—A telegraph company given the right by an act of Congress to occupy post roads with its poles and wires is held, in Toledo *vs.* Western Union Teleg. Co. (C. C. A. 6th C.) 52 L. R. A. 730, not to acquire such right free from the power of a municipal corporation to regulate the use of its streets, but must submit to local regulations for obtaining permission to string wires in public streets.

RIGHT OF WAY AND TRACKS OF A RAILWAY COMPANY NOT LANDED PROPERTY—The right of way and tracks of a railroad company are held, in United Railways & Electric Co. *vs.* Baltimore (Md.) 52 L. R. A. 772, not to be landed property within the meaning of a provision in a statute annexing territory to a city, that the rate of taxation on landed property in the annexed district should not be increased until streets were laid through it and there were a certain number of buildings on every block.

A TELEPHONE COMPANY MUST MAINTAIN APPLIANCES TO GUARD AGAINST LIGHTNING—A telephone company having reasonable grounds to apprehend that lightning will be conducted over its wires into a house where it maintains an instrument under contract with a subscriber, and there do injury to persons or property, is held, in Griffith *vs.* New England Telep. & Teleg. Co. (Vt.) 52 L. R. A. 919, to be chargeable with the duty to exercise due care in selecting, placing, and maintaining, in connection with its wires and instruments, such known and approved appliances as are reasonably necessary to guard against such accidents.

ELECTRIC RAILWAYS

READING, PA.—The Oley Valley Railway has begun operation between Reading and Friedensburg.

PENDLETON, IND.—A company has been organized to construct an electric line from Pendleton to Newcastle.

EL PASO, TEX.—The work of constructing the electric railway has been begun, a force of about fifty men having been set to work.

ST. ALBANS, VT.—The Street Railway Company is laying the foundation for a car house and power station, which is to cost about $20,000.

ST. LOUIS, MO.—Work has been begun by the Terminal Railroad Association on its World's Fair belt around North St. Louis to the fair grounds.

NEWARK, OHIO—The work of constructing the Newark & Marion trolley line has been begun by the contractors, Messrs. Taylor & Tylee, of Worcester, Mass.

SEYMOUR, IND.—Senator Schneck is interested in a company which has been organized to construct an electric railway from Seymour to New Albany.

DAYTON, OHIO—The Dayton & Western Traction Company has been granted a franchise to operate a railway from Eaton to the Ohio and Indiana state line.

RAPID CITY, S. D.—Mr. E. H. Hammond, of Kansas City, has purchased the street car line. It is said that the track will be placed in running order immediately.

POULTNEY, VT.—The Granville & Poultney Electric Railway Company has just been organized. Mr. William Nathaniel has been elected president of the company.

CHICAGO, ILL.—The Aurora, Wheaton & Chicago Electric Railway, which is now being built, will be operated by the third-rail system instead of by the overhead trolley.

WATERBURY, CT.—The Connecticut Railway and Lighting Company has applied to the railroad commissioners to construct an electric railway from Oakville to Waterbury.

PITTSBURG, KAN.—The board of directors of the Pittsburg Electric Railway Company has decided to extend the electric system to several mining camps north of Pittsburg.

COLUMBUS, OHIO—The operation of the Columbus, New Albany & Johnstown Electric Railway has been begun as far as Rarig. It is expected that the line as far as Gabana will soon be completed.

CHICAGO, ILL.—It is said that the electric railway company operating the line between Chicago and Joliet is negotiating with the Lake Street Elevated Railway to carry its passengers into the city and land them at the Market street terminal.

CLEVELAND, OHIO—The Cleveland Traction Company has been incorporated at Columbus. Mr. Frank DeHaas Robison, well known in baseball circles, is among the incorporators. It is said to be the intention of the company to build several new electric lines in Cleveland.

RACINE, WIS.—In the power plant of the Milwaukee Electric Railway Company at Racine, Wis., on the afternoon of November 4, a pulley broke causing the wreck of an engine, a dynamo and switchboard. Flying fragments drove the employés to places of safety, and but for the presence of mind of one of the engineers who shut off the steam, the entire plant might have been wrecked. The damage done is said to have amounted to about $25,000. The machinery which was destroyed was used in lighting the city.

ELECTRICAL SECURITIES

The amicable solution during the week just passed of the various problems growing out of the contest over the Northern Pacific Railroad property is viewed with considerable satisfaction by Wall street interests. The main object achieved is the assured stability of the rate situation in the western states. It puts an end to competitive and unnecessary railroad construction, and it is believed that the financial interests of the entire country will be benefited. The stock market rose on this news and then broke again upon the appearance of the actual facts. This is one of the peculiarities of the Wall street market.

The questions that seem to attract interest just now are the money market and what Congress may do respecting the monetary situation, particularly with reference to the excessive revenues of the treasury.

The industrial activity of the country is as great as ever, and there are no signs of letting up. Reports from all manufacturing centres indicate a demand several months ahead of the supply.

The recent publication in the ELECTRICAL REVIEW of the extent and financial strength of the electric lighting industry, which has been quite widely quoted, has attracted attention to the value of these properties. There is scarcely an electric lighting company in the country, from moderately sized cities up to cities of the first class, but what is overtaxed by the demand for electricity for lighting and power purposes.

Electric traction is also receiving more and more attention by investors. There has been a small, but quite general advance throughout the country during the past few weeks of securities of this nature, and there is a very cheerful tone to be observed by present owners. The value of electrical franchises was never so noticeable and so widely, as well as justly, appreciated as at the present time.

The surplus of the New York banks for the week ending November 16 was $10,102,000, an increase of about $1,500,000 over the previous week.

ELECTRICAL SECURITIES FOR WEEK ENDING NOVEMBER 16.

New York:	Closing.
Brooklyn R. T.	68⅝
Con. Gas	220¼
Gen. Elec	260
Man. El	129½
Met. St. Ry	167¾
Kings Co. Elec	190
N. Y. & N. J. Tel. Co	167
Telep., Tel. & Cbl. Co	6½

There has been considerable talk about the absorption by the Metropolitan Street Railway Company of the Brooklyn Rapid Transit Company. It is looked upon as the logical outcome of the transportation question in greater New York for these two great companies to unite. Ex-President Clinton L. Rossiter, of the Brooklyn system, who recently resigned, had brought the equipment and trackage of this road to an excellent state of efficiency, and the property is undoubtedly a magnificent one with unusual prospective value. The system will require, however, much additional investment to keep up its equipment and take care of the natural growth of the territory it occupies.

On the curb the stock of the United Railways of St. Louis has been active of late, the common selling around 31 and the preferred 88. Insiders are said to have been placing large orders on the market and are very bullish on these stocks. Strength is said to be due to the increased earnings reported of late and also to the large benefits the company will undoubtedly derive from the World's Exposition to be held in St. Louis in 1903.

It is stated that the net earnings for the Metropolitan Street Railway for the first quarter of the current fiscal year amounted to $1,038,000. As the quarter's dividend calls for $910,000, this will leave a surplus for the quarter of $128,000, which is regarded as very satisfactory. On every line where electricity has been introduced a reduction in operating expenses and an improvement in gross earnings have been made. There is still great possibility of reduction of operating expenses as a large number of the lines owned by this company are still operated by horse-power. It is thought that it will require probably $10,000,000 to make this change on all the horse-car lines to electricity, and it is thought that the underground trolley system will be used.

Boston, November 16:	Closing.
Am. Telep. & Tel.	157¼
Erie Tel.	21
New Eng. Tel.	132½
Mass. Elec. pf.	94
Westing. Mfg. pf.	78
Edison Elec.	245

The annual meeting of the Massachusetts Electric Companies for the year ending September 30, it is said, will show net earnings of about $800,000. This will leave a fair margin above the $720,000 required to pay preferred stock dividends and interest charges. The company is expending a large amount of money in betterments.

Philadelphia, November 16:	Closing.
Elec. Co. of America	6½
Philadelphia Elec.	5⅛
Union Traction	30½
United G. I. Co.	116½
Elec. Stor. Bat. c	58
Elec. Stor. Bat. pf	58

A director of the Union Traction Railway Company in an interview says: "The matter of a dividend on the stock and an assessment to pay for capital expenditures originally made out of earnings may be acted on in December, but it has not been formally considered yet. The probabilities are that an assessment of $5 per share will be made next year, half of which may be made payable in January and, as has been understood, a dividend declared at the same time. The company's earnings have been excellent, and so far the current year, or from July 1, shows an increase of about $160,000 in the gross."

It is stated that a settlement has been effected between the factions warring over the street railway franchises.

The story has it that the Widener-Elkins people have bought $5,000,000 of the Asphalt first fives from the Foederer-Mack people, paying 80 for them, and that the street railway franchises will be turned over to the representatives of the Union Traction Company.

Chicago, November 16:	Closing
Central Union Tel.	82
Chicago Edison Light	158
Chicago Telep.	250
National Carbon	20
National Carbon pf.	82½
Un. Trac.	13½
Un. Trac. pf.	51
Metropolitan El.	91⅞

A stockholder of the Central Union Telephone Company has asked that a receiver be appointed because of alleged manipulation of stock by interests identified with American Telephone and Telegraph Company.

The Chicago Electric Traction Company reports for the year ending October 31, 1901: Gross earnings, $96,561; operating expenses, $80,216; net earnings, $16,345.

PERSONAL MENTION

DR. J. G. RUCKER has begun the construction of a long-distance telephone from Coffeyville, Kan., to Wagoner, I. T.

DR. JULIUS PRECHT, associate professor of physics at Heidelberg, has been called to the Technical Institute at Hanover.

MR. CHARLES H. BRADLEY, of Chicago, has been appointed receiver of the Pana Electric Street Railway Company, of Pana, Ill.

MR. JOHN ENOCH, of Kansas City, has been granted a franchise to establish and maintain a telephone system in Kansas City.

MR. J. S. HEALY has been appointed manager of the Corning Exchange of the Century Telephone Company in Corning, N. Y.

PRESIDENT BALDWIN, of the Long Island Railroad, has announced that the company will build a trolley road at Sea Cliff from the railroad station to the steamboat dock.

MR. R. C. BROWN, who is the general manager of the San Paulo Tramway, Light and Power Company, Limited, of San Paulo, Brazil, is at present in the United States.

MR. STUYVESANT FISH, of New York, has been elected president of the Dubuque & Sioux City Railway Company, of Dubuque, Iowa, at the annual meeting of the stockholders.

COLONEL C. C. HOWELL AND MR. R. W. AUSTIN have been in the mountains examining the site of a dam across the Little Tennessee River for erecting an electric power plant in Tennessee.

PROFESSOR ARTHUR W. SMITH has received an appointment to a professorship of electricity and electrical engineering in the University of Missouri. Professor Smith was at Tulane University last year.

MR. JAMES E. HOLYOKE, well known in telephone circles in the West, is now connected with the Columbia Telephone Manufacturing Company, of Chicago, in the capacity of superintendent of construction.

MR. EDWARD WHITTAKER, who was formerly president of the St. Louis Rapid Transit Company, and has just returned from Europe, is said to be interested in the project to electrify the tramway system of St. Petersburg, Russia, with Messrs. Murray A. Verner and Sellers McKee.

MR. EDWARD W. JEWELL, who was formerly president of the McIntosh Battery and Optical Company, has retired from that company and will in future devote his entire time and energy to pushing the business of the Jewell Electrical Instrument Company. Mr. George M. Willis, formerly connected with the latter company, has retired from it to enter other business.

AUTOMOBILE NOTES

DIRECTORS OF ELECTRIC VEHICLE COMPANY—The number of directors was reduced from thirteen to nine at the annual meeting of the stockholders of the Electric Vehicle Company. The following retiring members were reelected: Messrs. H. M. Byllesby, George Chapman, G. H. Day, P. T. Dodge, T. W. Goodrich, Albert A. Pope, A. L. River, I. L. Rice and F. C. Stevens.

RECORDS BROKEN—November 16, M. Henri Fournier broke the world's record for automobile speed in a race against time, on the Coney Island Boulevard, New York city. The speed attained over a measured mile was fifty-one and four-fifths. Mr. A. L. Riker made a world's record for electric vehicles, by traversing the mile in one minute and three seconds. Fournier's machine was a French explosion-motor racing machine of sixty horse-power.

INDUSTRIAL ITEMS

THE NEW PROCESS RAWHIDE COMPANY, of Syracuse, N. Y., is said to have secured orders for its specialties from a number of British electric traction systems through its English representative, George Angus & Company.

THE MALTY-HORNADAY COMPANY, Union Trust Building, Cincinnati, Ohio, has opened a brokerage office for the purpose of buying and selling first-class railway and municipal bonds and railway stocks. It also takes charge of the organization and capitalization of electric railways.

FARR & FARR, of Chicago, are much pleased with the demand for the line of "accommodation telephones" which they have been advertising of late. They are shipping these sets, which are sold at attractive prices, to all sections of the country, and they report that they have yet to get the first complaint.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it is having an unusually large demand for its new type Peerless incandescent lamp. It states that it has been improving its lamp gradually. The lamp is sold under strong guarantees, and the company is always glad of an opportunity to submit sample lamps for tests.

BAKER & COMPANY, of New York, have issued the eighth edition of their catalogue which contains data concerning the uses of platinum for different electrical purposes, and also for the many purposes to which platinum is now put in the arts, such as platinum crucibles and platinum dishes for various chemical analyses, and directions for the care and cleaning of platinum ware.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, of New York, furnished the 275 series alternating-current enclosed arc lamps, together with the regulators and switchboard for lighting the Cornwall Canal in Ontario, of which mention was made in the ELECTRICAL REVIEW of last week. These lamps are of 2,000 candle-power each. From six to thirteen lights are placed at each lock.

THE VICTOR COOLING TOWER COMPANY, of St. Louis, Mo., has issued catalogue No. 11, in which the Victor atmospheric water cooling system is described. It contains pictures of a Victor cooling tower used in an ice manufacturing plant, a Victor self-cooling condenser for electric light and street railway plants, also diagrams showing the operation of the Victor fan cooling tower as applied to ammonia and steam condensers in ice manufacturing plants, and many other interesting features.

THE CHEATHAM ELECTRIC SWITCHING DEVICE COMPANY, with its factory at Louisville, Ky., of which Mr. Samuel Bowman, of St. Louis, Mo., is general agent, has recently brought out an interesting variety of electrically operated track switches for trolley railways. The design of these switches is such as to ensure great stability and solidity of operation, and it is claimed by the makers that their use saves the wages of a switchboy and has proved of considerable economy on the various railroads on which the device is installed.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has issued bulletin No. 6. It is entitled "How to Construct Rural Telephone Lines" and contains a large amount of useful information on this subject. A large amount of practical information and facts in regard to telephones and telephone lines is also contained in the bulletin. This company has also issued bulletin No. 5 which contains information on transmitters and receivers in general and gives many points regarding the Kellogg transmitter.

THE SMITH & HEMENWAY COMPANY, 296 Broadway, New York city, is manufacturing an angular boring machine which enables the user to bore holes, etc., at any angle. This machine will obviate the difficulty often incurred in getting at positions where a straight machine would not reach, and where it would be impossible to make the desired opening. It is also calling attention to its Green Book containing a complete line of hardware specialties. This book will be sent on application to any one interested.

THE "JOURNAL OF PHYSICAL THERAPEUTICS," which is a quarterly international review of the applications of physical processes to medicine, has lately begun publication with offices in New York and London. The journal, from the appearance of its earlier issues, is destined to take its place as one of the higher class of publications devoted to the medical arts, and has already printed several communications of interest concerning the applications of electricity in therapeutics. The American editor is Dr. Margaret A. Cleaves.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a number of contracts for the installation of batteries of chloride accumulators. The Chicago Edison Company has added two batteries to its Adams street station. The Philadelphia Electric Company has added an additional battery to its system, and the Edison Electric Illuminating Company of Detroit has doubled the capacity of its installation. The Edison Electric Light Company of York, Pa., and the St. Paul Gas Light Company, of St. Paul, Minn., have each contracted for a large battery to be installed in their lighting stations.

THE MICA INSULATOR COMPANY, of New York, calls attention to the fact that it is the owner of eight United States patents, six British patents and one German patent for the manufacture of Micanite and the manufacture of electrical insulators from mica sheets. Among others, the following companies have acknowledged the validity of the patents and taken licenses under them: The General Electric Company, the Westinghouse Electric and Manufacturing Company, several leading British manufacturers of electrical apparatus and the Allgemeine Elektricitäts-Gesellschaft. It is the intention of the company to prosecute vigorously all infringements upon its patent rights.

NEW INCORPORATIONS

AKRON, OHIO—The Belt Line Construction Company. $5,000.

MOORHEAD, MINN.—The Fargo Gas and Electric Company.

MARIETTA, OHIO—The Washington County Traction Company. $250,000.

LANSING, MICH.—The Battle Creek & Marshall Traction Company. $200,000.

MADISON, WIS.—Antigo Telephone Company. $25,000. Incorporators: J. C. Spencer and others.

CHICAGO, ILL.—Economy Light and Power Company. Increased its capital from $400,000 to $850,000.

FARMINGTON, MO.—Farmington Telephone Company. Increased its capital stock from $5,000 to $10,000.

BUNKER HILL, ILL.—Bunker Hill Telephone Company. Increased its capital stock from $2,500 to $10,000.

BELLEFONTAINE, OHIO—The Bellefontaine Telephone Company. Increased its capital stock from $50,000 to $75,000.

MADISON, WIS.—Milwaukee Incandescent Light Company. $12,000. Incorporators: G. W. Chadbourne and others.

HERRIN, ILL.—Herrin Light and Power Company. $20,000. Incorporators: C. E. Ingraham, B. Bolinger and others.

CALDWELL, TEX.—Trans-Texas Telephone Company. $10,000. Incorporators: J. D. Giddings, Robert Leonard and others.

HARRISBURG, PA.—The Newton & Yardley Street Railway Company. $50,000. Mr. George Worstall is president of the company.

WILMINGTON, DEL.—United Railway and Light Company. $1,000,000. To furnish light, heat and power for electric railways.

ST. CHARLES, MO.—St. Charles Electric Light and Power Company. $30,000. Incorporators: J. D. Houseman, W. J. Murray and others.

PIERRE, S. D.—Sioux Falls Suburban and Traction Company. $1,000,000. Incorporators: P. F. Sherman, George M. Root and others.

PHILADELPHIA, PA.—The Huntingdon Valley Street Railway Company. $30,000. Incorporators: R. J. Purcell, T. F. Durham and others.

DENVER, COL.—The Carstarphen Electric Company. $15,000. To operate in Arapahoe County. Incorporators: Frederick C. Hardon and others.

HOUSTON, TEX.—Houston Electric Company. $2,075,000. To operate an electric line. Incorporators: G. C. Baldwin, C. H. Tylor and others.

ALLENTOWN, PA.—Lehigh & Carbon Traction Company. $90,000. To operate a line fifteen miles long, taking in all the towns between Allentown and Walnutport.

LA GRANGE, ILL.—La Grange Water, Light and Power Company. $260,000. To supply water, light, heat and power. Incorporators: A. G. Mills, J. H. Walker, Jr., and others.

NASHVILLE, TENN.—Tennessee Telephone and Telegraph Company. $10,000. To establish a new telephone system in Nashville. Incorporators: Sanford Duncan, C. R. Handley and others.

ALBANY, N. Y.—Elmira & Waverly Company. $200,000. To build and operate an electric road eighteen miles long between Elmira and Waverly. Directors are residents of Elmira.

ALBANY, N. Y.—The Otsego County Telephone Toll Line Company. $10,000. To operate telephone lines in the towns and villages of Otsego County. Directors: John Geer, L. Barker and others.

PELHAM, WESTCHESTER COUNTY, N. Y.—The Subway & Suburban Construction Company. $300,000. To construct railways. Directors: Frank V. Ainslie, Brooklyn; Dunbar Hunt, Henry D. McGowan, New York city, and others.

COLUMBUS, OHIO—The Cincinnati, Blanchester & Columbus Electric Railroad Company. The proposed road is to operate in the counties of Hamilton, Clermont, Warren, Clinton, Green, Fayette, Madison and Franklin, with terminals at Cincinnati and Columbus. Capital stock, $10,000. Incorporators: E. D. Smith, Roy J. Rice and others.

CLEVELAND, OHIO—Electrograph Company. $1,000,000. To manufacture and sell appliances and instruments for the transmission by electricity of fac-similes of writings, pictures, drawings, maps and other designs. Some of the directors of the company are: W. E. Bemis, New York; E. H. Bourne, Cleveland, Ohio; John F. Taylor, Chicago; F. B. Squire, Cleveland, Ohio; Charles R. Huntley, Buffalo, N. Y.; C. M. Palmer, New York city.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall. solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED NOVEMBER 12, 1901.

686,245 Electrical resistance; J. F. Bachmann, Vienna, Austria—Comprises a hollow, open-ended risistance-body, a circuit terminal contact at one end of the body, and an annular or piston-like terminal contact, shiftable within said body.

686,246 Electrical resistance; J. F. Bachmann, Vienna, Austria—A graduated resistance, comprising a number of divisions, each of a different specific resistance, and all of the same cross-section, and composed of mixture of a conductive and non-conductive material, with a conductive contact arranged to trail over said divisions.

686,272 Telephone-switchboard system; F. W. Dunbar, Chicago, Ill.—A calling telephone line, an individual connection-terminal for the line normally disconnected therefrom, and means for automatically connecting said terminal with the line when a connection is established therewith in response to the call.

686,288 Electrical steam boiler; C. E. Griffing, Hamilton, Ohio.

686,295 Liquid interrupter for electric currents; J. O. Heinze, Jr., Revere, Mass.

686,312 Hanger-board for series arc lamps; E. O. Lundin, Boston, Mass.

686,330 Electric transfer apparatus; H. H. Porter, Jr., Chicago, Ill.

686,340 Service-meter apparatus for telephone circuits; E. C. Robes, Medford, Mass.

686,349 Electric controller; G. J. Scott, Philadelphia, Pa.—A support, a series of contacts thereon, an elongated contact-strip parallel therewith, a movable brush adapted to coact with the said strip and contacts, an endless carrier on which said brush is mounted, supporting-wheels for said carrier, and means for actuating the same.

686,350 Strong current protector; A. A. Seeley, Chicago, Ill.

686,395 Apparatus for electrocoppering metals; E. L. Dessolle, Levallois-Perret, France.

(Continued on page 38.)

McINTIRE'S PATENT
Connectors and Terminals.
Special Connectors for HARD-DRAWN COPPER WIRE, all sizes. FUSED WIRE, FUSED LINKS and STRIPS.
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Expert Examinations of Patent Office Records.
Abstracts of File Wrappers of Applications before Patent.
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GEO. H. BENJAMIN, M. E., Ph. D.
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Specialty: The preparation of specifications for patents requiring an expert knowledge of the arts and sciences. Searches.
Highest References.

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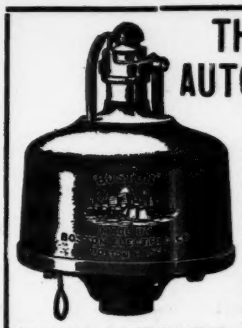
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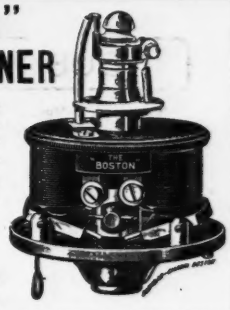
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Examinations made and reports furnished on all classes of industrial properties
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PATENTS.

(Continued from page 37.)

686,402 Magnetic separator; T. J. Greenway, East Adelaide, South Australia.

686,416 Alternate-current transmission; W. M. Mordey, Westminster, England.

686,419 Conduit for electric wires; E. D. Page, Brooklyn, N. Y.—A conduit adapted to receive one or more wires or the like, and provided with a cover having transverse grooves or corrugations to permit the cover to be bent laterally, and means for holding the cover upon the conduit.

686,423 Telephone cabinet; E. W. Smith, St. Catharines, Canada.

686,434 Distribution of electric currents; E. Arnold, Carlsruhe, Germany.

686,443 Rosette for electric wiring; J. H. Cramphorn, Medford, Mass.

686,459 Electric cutout for emergencies; J. H. Johnson, Newark, N. J.

686,481 Trap; C. M. Shafer, McDonald, Pa.

686,488 Telephone receiver; W. F. Taylor, Brookline, Mass.

686,507 Electric meter; J. Cauderay, Lausanne, Switzerland.

686,524 Electric showcase fixture; E. A. Lowe, Plainfield, N. J.—A hollow support, attachable to the frame of a showcase, and provided with a cylindrical surface with an opening therethrough to the interior of said support, and a hollow bracket for supporting an electric lamp, and having a concave cylindrical base located over said opening and provided with transverse slots for the passage of screws into said support.

686,525 Electric furnace; J. H. Morley, Springfield, Mass.

686,526 Electric bell; J. F. Mossop, Philadelphia, Pa.

686,541 Third-rail safety system for electric railroads; C. Schlechteger, Nantasket, Mass.

686,551 Electric furnace; A. Simon, Bordeaux, France.

686,558 Apparatus for manufacturing tubes, pipes, etc.; E. Thomson, Swampscott, Mass.

(Concluded on page 40.)

WANTED—SEVERAL PERSONS of character and good reputation in each state (one in this county required) to represent and advertise old established wealthy business house of solid financial standing. Salary $18.00 weekly with expenses additional, all payable in cash each Wednesday direct from head offices. Horse and carriage furnished, when necessary. References. Enclose self-addressed stamped envelope. Manager, 316 Caxton Building, Chicago.

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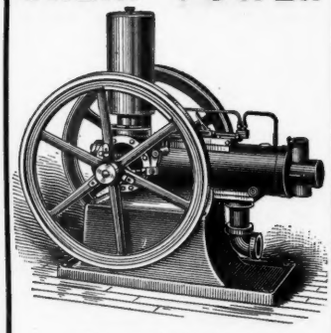

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